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AUTHOR Biondo, Ron; And Others
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ABSTRACT

This second volume of a 2-volume curriculum guide contains 12 problem areas selected as suggested areas of study to be included in a core curriculum for 10th-grade or second-year students enrolled in a metropolitan agriculture program. The 12 problem areas are divided into 5 units: Growing and Managing Horticultural Crops (4 problem areas), Identifying and Controlling Pests of Horticultural Plants (1), Soil Science and Conservation of Natural Resources (1), Agricultural Production (2), and Landscape Design Establishment and Maintenance (4). Each problem area includes some or all of the following components: suggestions to the teacher, teacher's guide (objectives, suggested interest approaches, anticipated student problems and concerns, suggested learning activities, suggested uses of problem area, evaluation, references and aids), information sheets, student worksheets or assignment sheets and key, job sheets or laboratory exercises, transparencies, discussion guide for transparencies, and sample test questions and teacher's key. (YLB)

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CORE II MATERIALS FOR METROPOLITAN AGRICULTURE/ HORTICULTURE PROGRAMS

UNITS G-L

Project Staff

Co-directors:
Paul Hemp
Roger L. Courson

Developers:
Ron Biondo
Jim Ethridge
Paul Hemp
Jerry Pepple
Marcia Watman

Department of
Vocational and
Technical Education
and Vocational
Agriculture Service,
University of Illinois
at Urbana-Champaign

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Product Abstract

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(217) 782-4620

16. General Description (State the general objective and suggested method in use. Summarize the content and tell how it is organized. Continue on back of this sheet or on another sheet, if necessary.)

This curriculum guide includes 28 problem areas selected as suggested areas of study to be included in a core curriculum for tenth-grade or second-year students enrolled in a metropolitan agriculture program.

17. Person Completing this Abstract: Paul E. Hemp

Full Address: 357 Education Bldg.
1310 S. Sixth St.
Champaign, IL 61820

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UNIT G: Growing and Managing Horticultural Crops

PROBLEM AREAS:

1. Growing bedding plants
2. Growing greenhouse flowering crops from seeds and cuttings
3. Growing container nursery crops
4. Growing bulb crops

UNIT G: GROWING AND MANAGING HORTICULTURAL CROPS

PROBLEM AREA: GROWING BEDDING PLANTS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the spring semester. The estimated instructional time for this problem area is 5 to 10 days, depending on how far the teacher wishes to go in developing bedding plant growing skills at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be 5 days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The materials in this problem area were selected and written with the following assumptions:

1. A practical review of seeding practices will be held by January or February.
2. Reference will be made to the problem area "Identifying and Using Structures Used in the Production of Plants" in Core I.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as the instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, student worksheet, and test questions were developed by Jim Ethridge, Agriculture Department, Joliet Junior College, and Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Pilot Test Teachers.

TEACHER'S GUIDE

I. Unit: Growing and managing horticultural crops

II. Problem area: Growing bedding plants

III. Objectives: At the completion of this problem area students will be able to:

1. Sow the seeds of a bedding plant crop.
2. Plan a schedule for a bedding plant crop.
3. Identify three diseases that commonly attack a bedding plant crop.
4. Transplant a bedding plant crop.
5. Order seeds from a seed catalog.
6. Successfully grow or produce a bedding plant crop.
7. Harden off plants before they are sold.

IV. Suggested interest approaches:

1. Compile a list on the chalkboard of all the bedding plants the students can recall. Ask them:
   - a. Which are your favorite?
   - b. Which do you think are the most common?
   - c. What makes some bedding plants sell better than others?
2. Ask the students if they think the common bedding plants sold can be found in nature. Then ask how the industry has developed the bedding plants.

V. Anticipated problems and concerns of students:

1. What is a bedding plant?
2. What is an All American Selection?
3. How are bedding plants used in the landscape?
4. How is a bedding plant seeding schedule developed?
5. What are the different methods of sowing seed?
6. How deep are seeds sown?
7. How many seeds does one sow?

8. What are the most important bedding plants?

9. What bedding plants are grown from cuttings?

10. How are seeds ordered?

11. What is an F_1 hybrid?

12. What seeds are dicots? monocots? hypoegous? epogeous?

13. What seeds are directly sown into the garden?

14. What automated machinery is available for planting seeds?

15. What is pelleted seed?

16. How is a work bench organized for transplanting seedlings?

17. What growing media is used in growing bedding plants?

18. What is the best way to water seeds? seedlings? transplanted seedlings?

19. How are seeds, seedlings and transplants fertilized?

20. How are bedding plants prepared for shipping?

21. How are bedding plants cared for in the retail garden center?

22. What bedding plants do well in a shaded area?

23. What bedding plants do well in wet locations?

24. What vegetables are grown as bedding plants?

25. What insects attack bedding plants in the greenhouse?

26. What diseases attack bedding plants in the greenhouse?

27. What is meant by hardening-off?

28. How are oasis and seed cakes used in seeding bedding plants?

VI. Suggested learning activities and experiences:

1. Sow seeds using the Worksheet "Sowing Seeds."

2. Have each student schedule 10 flowers using the Worksheet "Timing Flowers and Vegetables."

3. Have groups of students collectively complete the Worksheet "Let's Take a Look at a Wholesale Seed Catalog."

4. Have students read the VAS unit #5010a "Growing Flowering Annuals" and answer some of the anticipated student questions and concerns.

5. Have the students read the Ohio State Extension Service bulletin #MM 265 "Tips on Growing Bedding Plants."

6. Have the students complete the Worksheet "Bedding Plant Selection."

7. Each student should be assigned seeds to grow from germination to sale. The student should be responsible for suggesting varieties to order, helping place the order, cataloging in the order, planting the seed, hardening-off the seedlings, transplanting, as well as other cultural practices which will result in a crop ready for sale at the scheduled time. The student may be grouped and each group take several crops to grow or each student might have one or two crops to be grown individually. Students can share their growing crop experiences in class or while working the greenhouse. More advanced students can help others.

8. Have the students complete the Worksheet "Bedding Plant Scheduling."

9. With several seed catalogs, compare seed and growing information on bedding crops such as petunias, marigolds and zinnia. Vegetable crops should also be considered.

10. Have the students complete the Worksheet "Design Your Flower Bed."

11. Take a field trip to a local bedding plant grower and investigate what crops he or she grows from seed, what crops they purchase as seedlings, and what crops he or she has chosen not to grow. Examine the whys of each of these activities.

12. Investigate the growing of bedding plants in open flats, open benches, and in cell packs. Examine the advantages of each as well as the limitations. Derive a conclusion as to which management technique you will use in growing your crop.

13. As a class project, grow a greenhouse crop of bedding plants. Keep accurate records on each crop. These records kept by each individual can serve as the S.O.E.P. for each student and provide a means of comparison of record-keeping ability. These records can be entered in FFA and N.J.H.A. competitions.

14. Take a field trip to a seed propagator who germinates seeds and sells them to others for growing on the seedlings and selling them. Evaluate why such a specialized grower exists and how your school might be able to use plants grown in this manner.

15. Divide the students into groups caring for similar bedding plants and compare the progress of each group of students and bedding plants as they progress toward sale date. Compare the end products.

VII. Application procedures:

1. Having high school students with growing bedding plant experience can be an asset to those students who will work in the retail garden center.

2. Students with bedding plant production knowledge can be a benefit to parents and neighbors who are planning vegetable gardens and bedding plant borders. Selection of the proper variety and plant material will be useful.

3. Information in the problem area as it relates to the keeping of records about bedding plant production will assist the student in making a career choice about the growing of bedding plants.

VIII. Evaluation:

1. Prepare and administer an objective paper and pencil test covering the material you present from this problem area.

2. Evaluate worksheets completed by the students.

3. Conduct a practical performance test using the crops grown by the students.

IX. References and aids:

1. Bedding Plants, (a manual on the culture of bedding plants as a greenhouse crop), by John W. Mastalerz, published by the Pennsylvania Flower Growers, 1976.

2. Ohio State University Cooperative Extension Service, "Tips on Growing Bedding Plants" Bulletin MM265.

3. George J. Ball, Inc. Box P300, West Chicago, IL 60185 (312) 231-3500.

   a. Ball Bedding Book, by Vic Ball, 1977
   b. "Grower Talks" (a monthly publication)
   c. Bedding Plant Calculator, (a cost is involved)

4. Information Sheets included in this problem area:

   a. "Bedding Plant Time Tables"
   b. "The Uses of Bedding Plants"
   c. "Sample Flower Bed Design"

5. Information Sheets found in Core II problem area "Identifying Annual and Perennial Flowers in the Landscape":

   a. "Partial Listing of Major Seed Companies"
   b. "Garden Flowers, Partial List of Catalogs"

6. Transparencies and Transparency Discussion Guide found in Core I problem area "Planting Plants."

INFORMATION SHEET

BEDDING PLANT TIME TABLES*

Kind	Approximate Time in Germination Environment Days	Temp. at Which to Grow Seedlings After Germ.	Time From Seeding to Transplanting (Weeks)	(Night) Growing on Temperature After Transplanting	Time From Transplanting to Bloom or Sale (Weeks)	Total Time For Crop	General Comments
Ageratum	4	70° for 1 week then 50°	4	50° 60° 70°	8 - 9 6 - 7 5 - 6	12-13 weeks 10-11 weeks 9-10 weeks	Grow at least 50° - Ageratum will freeze easily and grow poorly at lower temperatures. These growth rates are for F-1 hybrids. Open pollinated varieties require two weeks longer to bloom.
Alyssum (Annual)	3	50° - 55°	4	40° 50° 60°	7 5 3	11 weeks 9 weeks 7 weeks	Some growers prefer direct seeding. Mostly growers transplant in clumps, so seed usage is heavy.
Aster	5	60°	3	50° 60° 70°	6 4 3	9 weeks 7 weeks 6 weeks	Some dwarf varieties will throw blooms in 8 weeks at a height of 8 inches. Tall varieties will not bloom in packs.
Balsam	5	60°	3	60° 65° 70°	5 4 3	8 weeks 7 weeks 6 weeks	Keep Balsam on the dry side. Do not start too early. After blooms begin rate of growth is very rapid.

INFORMATION SHEET (cont.)

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Begonia (fibrous rooted)	14 - 21	70° for 2 weeks then 60°	8	50°(2)	8	16 weeks	Even with high light intensity Begonias germinate unevenly and seedlings should be transplanted by size.
				60°	7	15 weeks	
				70°	6	14 weeks	
Browallia	7	60°	4 - 5	55°	12	16-17 weeks	Sold mainly for pots, basket and patio pot planting in shady areas.
				65°	11	15-16 weeks	
				75°	10	14-15 weeks	
Calendula	7	50° - 55°	4	40°	5	9 weeks	Usually will not bloom well in packs. Should not be offered as a bedding plant in areas with extreme summer temperatures.
				50°	4	8 weeks	
				60°(1)	3	7 weeks	
Carnation	7	55° - 60°	6	45°	8	14 weeks	Plants will not bloom in packs. After transplanting when plants are 3 inches tall pinch once to induce break. Early sowing results in weak, straggly plants.
				50°	6	12 weeks	
				60°	5	11 weeks	

(1) This temperature is too warm to produce quality plants

(2) This temperature is too cool to produce quality plants.

INFORMATION SHEET (cont.)

BEDDING PLANT TIME TABLES*

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Celosia	5	65°	4	55°(2)	6	10 weeks	Celosias cannot stand a check in growth. Do not attempt to delay with cool temperatures. Do not allow seedlings in seed flats to over grow. Grow slightly dry.
				65°	5	9 weeks	
				75°(1)	4	8 weeks	
Centaurea cyanus	5	55°	3	50°	4	7 weeks	Will not bloom in flats. Become leggy and straggly if kept in flats too long.
				60°	3	6 weeks	
				70°(1)	3	6 weeks	
Coleus	7	60°	3	50°(2)	7	10 weeks	Damp off easily, so sow very thin. When transplanting do not plant too deep.
				60°	5	8 weeks	
				70°	4	7 weeks	
Dahlia	3	55°	3	55°	6	9 weeks	Do not start too early since Dahlias will outgrow the flats very rapidly.
				65°	5	8 weeks	
				75°(1)	4	7 weeks	

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Kind	Approximate Time in Germination Environment Days	Temp. at Which to Grow Seedlings After Germ.	Time From Seeding to Transplanting (Weeks)	(Night) Growing on Temperature After Transplanting	Time From Transplanting to Bloom or Sale (Weeks)	Total Time For Crop	General Comments
Dianthus	5	50°	4	50°	7	11 weeks	At warm temperatures plants get very leggy. Be sparing on fertilizer. There are big differences in timing of different varieties.
				60°	6	10 weeks	
				70°(1)	5	9 weeks	
Dusty Miller (Centaurea Candid.)	6	60°	6	50°	9	15 weeks	All Dusty Millers are very susceptible to damping-off so seed should be planted thinly for areation. The seedlings develop slowly but should be transplanted as soon as they can be properly handled. South of the Mason Dixon line timing of these two kinds can reverse.
				60°	8	14 weeks	
				70°	7	13 weeks	
Dusty Miller (Centaurea Gymnocarpa Cineraria Maritima)	10	60°	5	55°	8	13 weeks	
				65°	7	12 weeks	
				75°	6	11 weeks	
Geranium	5	60°	2 - 3	50°	15	17-18 weeks	Transplant seedling when they are small and keep plants growing. Do not transplant too deep.
				60°	13	15-16 weeks	
				70°	12	14-15 weeks	

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BEDDING PLANT TIME TABLES*

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Impatiens	7	60°	4	55° 65° 75°(1)	6 4 3	10 weeks 8 weeks 7 weeks	If grown cool plants are very susceptible to pythium rot. Always keep in mind that direct sunlight inhibits germination and retards growth.
Kochia	7	70°	2	60° 65° 70°	3 2 2	5 weeks 4 weeks 4 weeks	Do not bloom. Must be described on label to sell. Not suitable for damp cool climates.
Larkspur	21	50°	6 - 7	40° 50° 60°	6 6 5	12-13 weeks 12-13 weeks 11-12 weeks	Do not offer as a bedding plant item except in areas with long periods of cool weather.
Lobelia	5	50°	4	40° 50° 60°	7 6 5	11 weeks 10 weeks 9 weeks	Transplant in clumps. If seedlings become too tall clip before transplanting. Do not sow seeds too thick.

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Marigold Dwarf	3	60°	3	55° 65° 75°	9 7 6	12 weeks 10 weeks 9 weeks	Grow dry to prevent stretch. Grows best in bright light.
Marigold Tall	3	60°	3	55° 65° 75°	4 3 2	7 weeks 6 weeks 5 weeks	Will not bloom satisfactorily in packs or flats. Must be sold green.
Nierembergia	14	55°	5 - 6	50° 60° 70°	10 9 8	15-16 weeks 14-15 weeks 13-14 weaks	Does not bloom well in flats but a good item in all areas.
Pansy	7	50°	4	40° 50° 60°	12 10 9	16 weeks 14 weeks 13 weeks	Some gowers treat Pansys as a biennial and start seed outside in August. If grown too warm, plants stretch and flower size decreases.

INFORMATION SHEET (cont.)

BEDDING PLANT TIME TABLES*

Kind	Approximate Time in Germination Environment Days	Temp. at Which to Grow Seedlings After Germ.	Time From Seeding to Transplanting (Weeks)	(Night) Growing on Temperature After Transplanting	Time From Transplanting to Bloom or Sale (Weeks)	Total Time For Crop	General Comments
Petunia Double	7	60°	4	50°	8	12 weeks	Be sure to transplant all seedling if growing a mixture. Petunias do not bloom if daylength is less than 9 hours. If daylength is over 12 hours the plants will not stool out.
				60°	7	11 weeks	
				70°	6	10 weeks	
Petunia Single	5	60°	4	50°	6	10 weeks	
				60°	5	9 weeks	
				70°	4	8 weeks	
Phlox	8 - 10	55°	3	50°	7	10 weeks	Transplant seedlings when small and shade them for 24 hours after transplanting. If plants yellow increase temperatures.
				60°	6	9 weeks	
				70°(1)	5	8 weeks	
Portulaca	3	60°	6	50°	8	14 weeks	Portulaca damps-off easily and should be grown dry. Transplant in clumps or direct seed into flats.
				60°	7	13 weeks	
				70°	6	12 weeks	
Salvia	5	60°	3	55°	7	10 weeks	Transplant seedlings as soon as possible. Do not check growth.
				65°	6	9 weeks	
				75°(1)	5	8 weeks	

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BEDDING PLANT TIME TABLES*

Kind	Approximate Time in Germination Environment Days	Temp. at Which to Grow Seedlings After Germ.	Time From Seeding to Transplanting (Weeks)	(Night) Growing on Temperature After Transplanting	Time From Transplanting to Bloom or Sale (Weeks)	Total Time For Crop	General Comments
Snapdragon Dwarf	5	50°	4	40° 50° 60°	10 8 7	14 weeks 12 weeks 11 weeks	Keep cool at all times after transplanting. 60° temperatures will result in stretch. Dwarf Varieties will bloom in the flats but tall varieties will not.
Snapdragon Tall	5	50°	4	40° 50° 60°	6 5 4	10 weeks 9 weeks 8 weeks	
Verbena	5	60°	4	55° 65° 75°	7 6 5	11 weeks 10 weeks 9 weeks	Use well drained sterilized soil for germination also sow thinly to avoid damping off. Keep plants well ventilated until ready for sale.
Vinca rosea	10	70° - 75°	5	65° 75° 85°(1)	9 8 7	14 weeks 13 weeks 12 weeks	Keep warm at all times. At 60° growth is retarded and plants will begin to yellow - At 50° there is almost no growth and plants yellow badly.

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BEDDING PLANT TIME TABLES*

Kind	Approximate Time in Germination Environment Days	Temp. at Which to Grow Seedlings After Germ.	Time From Seeding to Transplanting (Weeks)	(Night) Growing on Temperature After Transplanting	Time From Transplanting to Bloom or Sale (Weeks)	Total Time For Crop	General Comments
Zinnia Dwarf	3	60°	3	55°(2) 65° 75°(1)	6 5 5	9 weeks 8 weeks 8 weeks	Peter Pan types shouldn't be planted more than 24 per 11 x 22 flat. Thumbelinas can be planted up to 72 plants per 11 x 22 flat. Do not plant more than 7 weeks before anticipated sale. Cool temperatures result in diseased plants and too warm in stretched plants.
Zinnia Tall	3	60°	3	55°(2) 65° 75°(1)	3 2 2	6 weeks 5 weeks 5 weeks	
Cabbage	3	55°	2½	45° 55° 65°	4 3 3	6½ weeks 5½ weeks 5½ weeks	Do not grow warm. Plants grow very fast and will be overgrown if planted more than six weeks before sale and if the weather turns warm.

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INFORMATION SHEET (cont.)

BEDDING PLANT TIME TABLES*

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Eggplant	7	60°	4	55° 65° 75°(1)	5 4 3	9 weeks 8 weeks 7 weeks	If grown too cool plants will not recover enough to be productive. Should not be sold until weather warms in late spring.
Onion	7	45°	-	40° 50° 60°	12 11 9	1 week 1 week 9 weeks	Should be direct seeded with seeds about ¼ inch apart and allowed to grow on. May have to be trimmed 1-2 weeks before sale. Early sowing results in better plants.
Pepper	7	65°	3	55° 65° 75°(1)	5 4 3	8 weeks 7 weeks 6 weeks	Transplant when true leaves are about 3/8 inches long. Do not cool to less than 50°. Do not sell too early because fruits will not set in cool weather.

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Tomato	5	60°	3	55° 65° 75°(1)	4 3 2	7 weeks 6 weeks 5 weeks	Time seeding for about 5-7 weeks before sale. If grown too cool the main stem will harden and result in poor fruit production all season.

(1) This temperature is too warm to produce quality plants.

*Dietz, C. F. 1976. Sowing Schedules. In Bedding Plants - A Penn State Manual, 2nd edition (J. W. Mastalerz, editor). pages 55-65. Pennsylvania Flower Growers, University Park, Pa.

INFORMATION SHEET

THE USES OF BEDDING PLANTS

SUNNY LOCATIONS:

Ageratum, Alyssum, Aster, F_1 Hybrid Fiberous Begonias, Bachelor Button, Calendula, Canna, Celosia, Cleome, Cosmos, Dwarf Dahlia, Fuchsia, Geranium, Hybrid Impatiens, Lantana, Marigolds, Pansy, Petunia, Annual Phlox, Portulaca, Salvia, Snapdragon, SpiderFlower, Verbena, Zinnia.

ANNUAL FLOWER GARDEN:

All Annuals.

EDGING:

Ageratum, Alternanthera, Alyssum, Begonia, Dwarf French Marigold, Foliage Geranium, Lobelia, Petunia, Periwinkle, Portulaca, Verbena.

FOLIAGE EFFECTS:

Alternanthera, Basil "Dark Opal," Amaranthus, Caladium, Coleus, Echeveria, Iresine, Perilla "Burgundy," Snow-on-the-mountain.

COMBINATION POTS, HANGING BASKETS, OR PORCH BOXES:

Ageratum, Alyssum, Browallia, Coleus, Celosia, Dusty Miller, Impatiens, Geranium, Fuchsia, Ivy Geraniums, Lobelia, Petunia, Periwinkle, Portulaca, Marigold, Tiny Tim Tomato, Verbena.

SPECIMENS ON PATIO:

Begonia, Boston Yellow Daisy, Fuchsia, Geranium, Dwarf to Medium Marigolds, Tall Lantana, Petunias.

BACKGROUND PLANTING:

Cleome, Cosmos, Flowering Tobacco, African Marigold, Salvia, Zinnia.

CUT FLOWERS:

Aster, Bachelor Button, Boston Yellow Daisy, Calendula, Celosia, Cosmos, Coreopsis, Annual Chrysanthemum, Annual Delphinium, Flowering Tobacco, Gaillardia, Godetia, Heliotrope, Medium to Tall Marigolds, Mignonette, Petunias, Salvia, Scabiosa, Tall Snapdragon, Stock, Sweet Pea, Sweet Sultan, Tall Verbena, Zinnia.

FRAGRANCE:

Alyssum, Basil "Dark Opal," Flowering Tobacco, Heliotrope, Mignonette, Petunia, Phlox Drummondi, Scabiosa, Snapdragon, Stock, Sweet Pea.

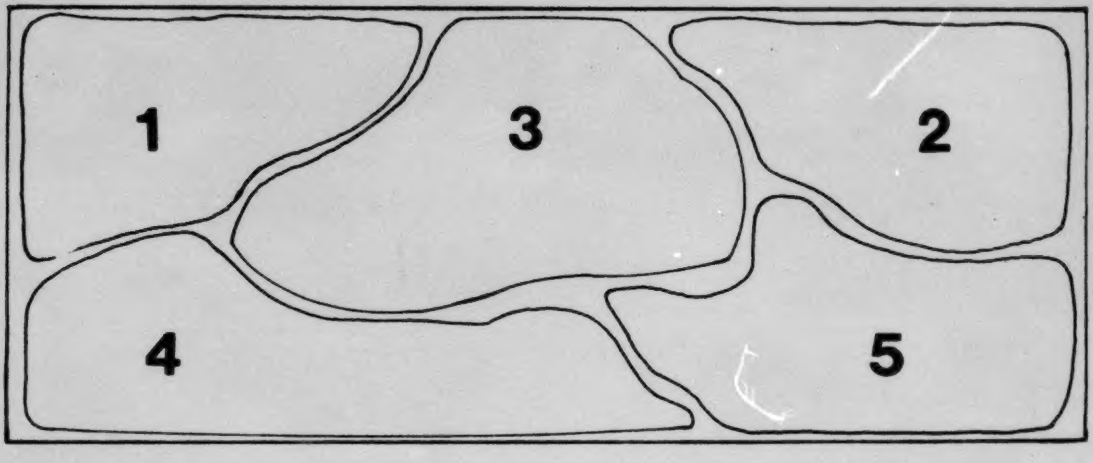
TOLERANT OF POOR SOIL:

Alyssum, Amaranthus, Balsam, Bachelor Button, Browallia, Calendula, Celosia, Cleome, Coreopsis, Gaillardia, Godetia, Marigold, Petunia, Portulaca, Zinnia.

INFORMATION SHEET

SAMPLE FLOWER BED DESIGN

The flower bed is exposed to full sun, a 3' high fence stands at the north border of this bed.



	Flower	Variety	Height	Color
1.	Marigold	Crackerjack Gigantic	30"	Yellow/Gold/Orange
2.	Snapdragons	Grand Ruffled Tetra	30"	Mixed
3.	Salvia	St. John's Fire	12"	Red
4.	Petunia	Bridle Bouquet	10"	White double
5.	Petunia	Fantasy	12"	Purple/White

WORKSHEET

DESIGN YOUR FLOWER BED

Design a flower bed for your back yard. Use no less than 6 different flowers and no more than 12. This bed will be exposed to full sun and will have adequate water throughout the summer. Use the Ball Seed Catalog to gather the necessary information. Use the following chart to list the varieties you chose.

	Flower type	Variety	Height	Color
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				

Further Comments to explain your design

1. What special effects were you trying to accomplish here?

WORKSHEET

LET'S TAKE A LOOK INTO A WHOLESALE SEED CATALOG

1. In what hardiness zone is Illinois?
2. What is the average minimum temperature in our zone?
3. List 5 All American selections listed in your catalog?

	Type	Variety
1.		
2.		
3.		
4.		
5.		

4. Define "All American selection."
5. What is the difference between a single and a double flower?
6. What is an annual? Give an example.
7. What is a biennial? Give an example.
8. What is a perennial? Give an example.
9. What is a "mixed" seed selection?
10. How many varieties of Marigolds are listed in your catalog?
11. How large across is the biggest zinnia flower?
12. What is seed tape?
13. What is pelleted seed?
14. In a one ounce measure, you will find . . .

______________ begonia seeds
______________ snapdragon seeds

WORKSHEET

BEDDING PLANT SELECTION

plant	variety	# flats	plants per flat	total # plants	color	spacing
AGERATUM	Blue Blazer	13				
ALYSSUM	Snowcloth	15				
ASTER	Ball Best of All Mixture	13				
DIANTHUS	Magic Charms	6				
MARIGOLDS	Cracker Jack Mixture	7				
	Gold Galore	8				
	Harmony Boys	19				
PETUNIAS	Fanfare Mix	10				
	Blue Frost	3				
	Fandango	6				
	Red Cascade	7				
	White Cascade	7				
	Blue Cascade	10				
PHLOX	Twinkle	17				
PORTULACA	Sunglo Mixture	6				
SALVIA	Victoria	4				
	St. Johns Fire	5				
SNAP-DRAGONS	Pixie Mixture	14				
VINCA	Little Bright Eye	7				
ZINNIA	Lilliput Formula Mix	(42)				
	State Fair Mixture					
BEGONIA	Linda	(17)				
	Mars					
	Viva					
IMPATIENS	Elfin Orange	7				
	Elfin White	6				
	Elfin Blue	6				
	Elfin Red	5				
	Elfin Pink	8				

WORKSHEET

BEDDING PLANT SELECTION (cont.)

plant	variety	# flats	plants per flat	total # plants	color	spacing
DUSTY MILLER	Fine Laced	10				
TOMATO	Better Boy VFN	36				
	Sweet-N-Early	4				
PEPPER	Better Belle	17				
CAULI-FLOWER	Snow Crown	14				
CABBAGE	Ruby Perfection	29				
	Golden Cross	14				
BRUSSELS SPROUT	Jade "E"	13				

WORKSHEET

BEDDING PLANT SCHEDULING

Congratulations!!!

You have just been awarded a 30'x60' glass greenhouse with steam heat. Inside, the greenhouse is equipped with 20 benches, each 12'x6'. Five hundred geraniums are due in, which will need a 8"x8" final spacing per plant. Easter lilies take up one and one half benches, african violets for Valentine's Day fill one bench, and foliage plants take up 72 square feet of space. You have received an order for all the tomato and pepper plants you can produce. The customer has requested that 60 percent of your product be tomatoes and 40 percent be peppers. The customer is requiring delivery date be May 30th. Also, the plants are to be grown on the AC-6-10 paks (60 plants per flat).

1. How many square feet of growing space is available on 20 benches?
2. How many square feet will be taken up by the geraniums?
3. How many square feet of space will be available for bedding plants?
4. How many benches will be available for bedding plants?
5. How many flats will fit in the available space?
6. How many flats of tomatoes are you to grow?
7. How many flats of peppers are you to grow?
8. What are the germination requirements and growing requirements for each?
9. What dates are the seeds to be sown?
10. What are the transplant dates?
11. How many boxes of flats should you order at 100 per box?
12. How many square feet of media do you need to fill your flats?
13. Using a mix of 2-2-1 (peat-perlite-soil), how much of each do you need?
14. How many bags of peat moss (6 cuft/bag) and perlite (4 cuft/bag) do you need to order?

WORKSHEET

SOWING SEEDS

I. Purpose:

To learn how to properly sow seeds.

II. Materials:

1. Clean sterilized container.
2. Jiffy mix, well saturated with water
3. Clean plant label.
4. Seeds

III. Procedure:

1. Fill container with jiffy mix to the top.
2. Moisten several times with water.
3. Level and firm the media.
4. Make depressions with plant level, approximately 1" apart (depth of depression depends of size of seed -- usually follow the rule 3 x seed diameter).
5. Sow seeds thinly in the depression. Tap the envelope with your forefinger to enable the seeds to roll out of the package at a uniform rate as you move the envelope along the line.
6. Cover large seeds with a layer of media. (Collapse side of the depression.)
7. Place in germination chamber. If a germination chamber is not available, container should be placed in a draft-free room out of direct sunlight. Temperature should be kept between 70-75 with the exception of seeds which must be germinated in a cooler temperature.
8. Check daily.
9. Transplant seedlings when they are big enough to handle -- usually after the first set of true leaves appear. (Approx. 1 week)
10. Write the proper information on the top half of the plant label. (Use pencil only.)
    Name
    Seed Type
    Variety
    Date

IV. Observations:

WORKSHEET

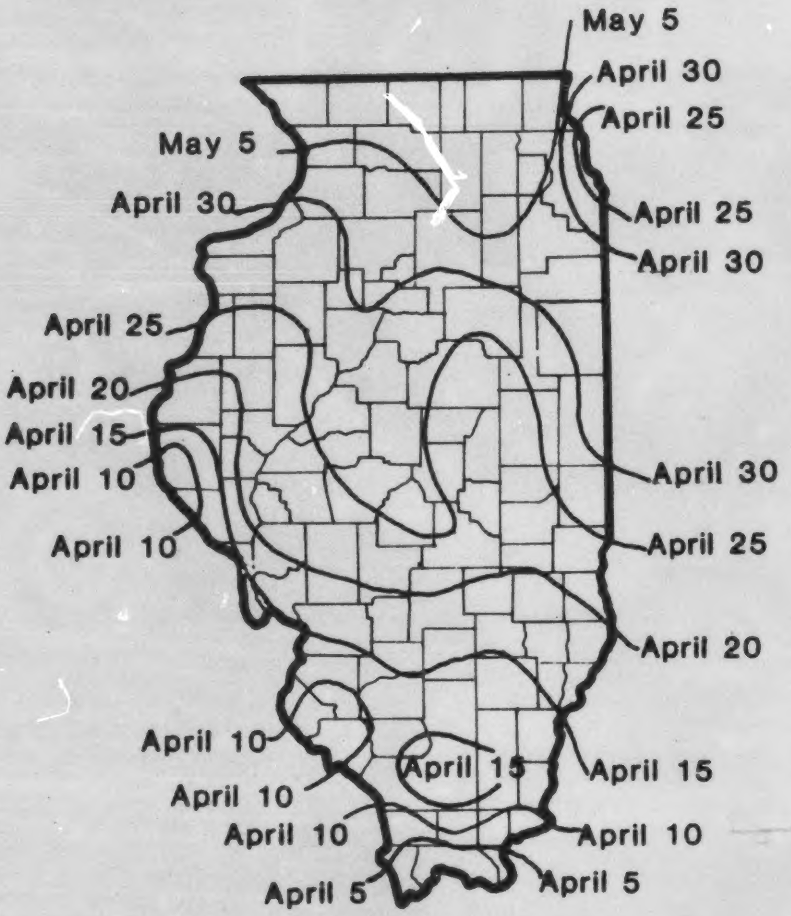
TIMING FLOWERS AND VEGETABLES

Flowers	Sowing Date	Number of Days to Germinate	Date Germination is Completed	(Date true leaves are formed) Transplanting Date	Weeks needed to grow for Saleable Plant	May 15 Plants Ready to Sell
Alyssum		8 (8)			4-6	
Coleus		10 (10)			10	
Marigold		7 (7)			4-6	
Pansy		10 (10)			12	
Petunia		10-12 (11)			8-10	
Salvia		12-15 (14)			4-6	
Snapdragon		2 weeks			6-8	
Vinca		15 (15)			6-8	
Pepper		10-20 (15)			6-8	
Tomato		6-14 (10)			6-8	

CALENDAR - MONTHS/DAYS

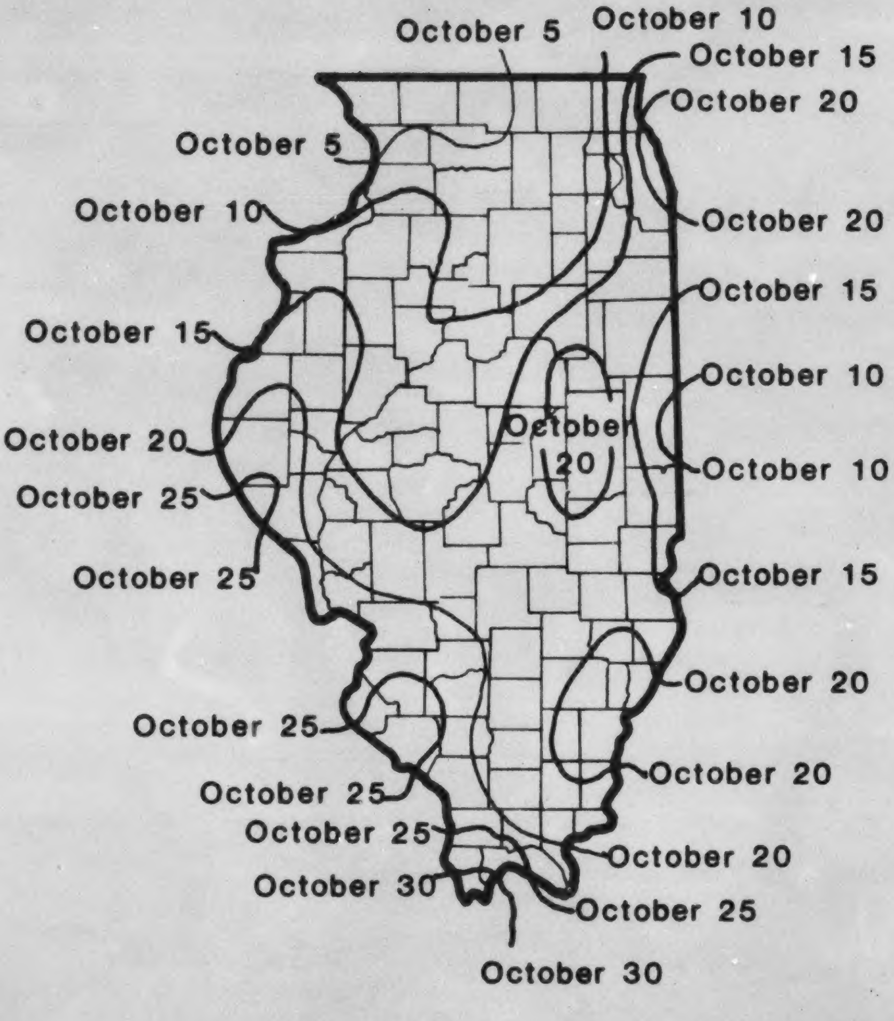
JANUARY 31 FEBRUARY 28 MARCH 31 APRIL 30 MAY 15

LAST FREEZE IN SPRING


May 5
April 30
April 25
May 5
April 30
April 25
April 30
April 25
April 20
April 15
April 10
April 30
April 10
April 25
April 20
April 10
April 15
April 15
April 10
April 10
April 10
April 5
April 5

Average dates of the last 32° F freeze in the spring There is a 50–percent chance that a freeze will occur on the dates shown. Marketing dates for bedding plants are generally 7 days after the average last freeze in spring.

FIRST FROST IN FALL


October 5
October 10
October 15
October 20
October 5
October 10
October 20
October 15
October 15
October 10
October 20
October 20
October 10
October 25
October 25
October 15
October 20
October 25
October 20
October 25
October 25
October 20
October 30
October 25
October 30

Average dates of the first 32° F. freeze in the fall. There is a 50–percent chance that a freeze will occur on or after the dates shown.

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

GROWING BEDDING PLANTS

Multiple Choice

B 1. When are bedding plants marketed in Illinois?
A. June
B. May
C. March
D. July

A 2. Which of the following are annuals?
A. Petunias, Marigolds, and Ageratum
B. Petunias, Roses, and Carnations
C. Iris, Marigolds, and Snapdragons
D. Peonys, Petunias, and Pansys

D 3. What material is used in soilless mixes?
A. Peat Moss
B. Perlite
C. Vermiculite
D. All of the Above

C 4. Why do growers use soilless mixes?
A. They are extremely inexpensive.
B. They never need to be sterilized.
C. They are lightweight.
D. They have little water-holding capacity.

C 5. Which are chemicals used to control pests?
A. Miticide, Osmocote
B. Herbicide, Dexonicide
C. Insecticide, miticide
D. Rodenticide, Systemicide

B 6. What is the best temperature range for germinating bedding plants?
A. 55° - 65°F
B. 65° - 75°F
C. 75° - 85°F
D. 85° - 95°F

C 7. When is it time to transplant seedlings?
A. Once they sprout
B. After they turn green
C. After they display their first set of true leaves
D. Once they are 2" tall

C 8. Seeds should be stored in a ______________.
A. Warm dry place
B. Warm moist place
C. Cool dry place
D. Cool moist place

A 9. How deep should seeds be sown?
A. It depends on the type of seed
B. About an inch beneath soil
C. On the soil surface
D. Near the bottom of the tray

B 10. Which bedding plant is commonly grown from cuttings?
A. Snapdragons
B. Geraniums
C. Marigolds
D. Alyssum

D 11. Which vegetables are commonly grown alongside bedding plants in the greenhouse?
A. Carrots and onions
B. Carrots and tomatoes
C. Green beans and broccoli
D. Tomatoes and peppers

D 12. Which annual can be sown directly in the garden?
A. Four-o'clocks
B. Moss roses
C. Begonias
D. Both A and B

D 13. A typical growing flat has ______ plants.
A. 50
B. 75
C. 80
D. 72

D 14. When growing bedding plants it is important to provide adequate
A. Moisture
B. Light
C. Space
D. All of the above

B 15. Dusting seeds with a fungicide is a common practice to prevent
A. Nemantodes
B. Damping-off
C. Hardening-off
D. Powdery mildew

Lists

16. What are six "insect" pests found in the greenhouse?
    1. Aphids
    2. Mites
    3. Scale
    4. Fungus gnats
    5. Mealy bugs
    6. White fly

17. Name three common diseases in the greenhouse.
    1. Damping off
    2. Powdery mildew
    3. Leaf spot

18. List two flowers which need to be shaded.
    1. Impatiens
    2. Begonias

19. Name four bedding plants with the same color flowers.
    1. Red salvia
    2. Petunia
    3. Canna lilies
    4. Begonias

20. List 4 types of pesticides.
    1. Fungicide
    2. Herbicide
    3. Insecticide
    4. Miticide

SCHEDULING PROBLEM:

You have a 50'x100' fiberglass greenhouse with forced hot air gas heat. Inside, the greenhouse is equipped with 50 benches each 6'x20'. 750 Geraniums are due in which will need a final spacing of 8"x8" per plant. Easter Lilies are taking up 1½ benches for an April 20th sale. Tulips take up 3 benches for Valentines Day. Foliage plants take up 2 benches. You have received an order for all the short Lemondrop Marigolds and red single Petunias you can grow. The customer has requested that 80 percent of the flats be Petunias and the rest be Marigolds. He is requiring a delivery date of May 1, 1981. The plants are to be grown in A-12 inserts which hold 72 plants per flat and .29 cubic feet of soil media. One bench holds 88 flats.

1. How many square feet of space will be taken up by the geraniums?
2. How many benches will the geraniums use?
3. How many benches will you not be able to use for flats?
4. How many benches will be available for bedding plants?
5. How many flats will fit on the available benches?
6. How many flats of petunias will you grow?
7. How many flats of marigolds will you grow?
8. What are the germination and growing requirements for each?
9. What are the dates the seeds are to be sown?
10. How many seeds do you need to order using the Ball Seed catalog? (List the price for each.)
11. How many boxes of flats should you order at 100 per box?
12. How many cubic feet of growing media do you need to fill your flats?
13. Using a mix of 5-3-2 (peat-perlite-vermiculite), how much cubic feet do you need of each?
14. How many bags of peat moss (6 cuft/bag), perlite (4 cuft/bag), and vermiculite (4 cuft/bag) do you need to order?

    Peat__________, Perlite__________, Vermiculite__________.

UNIT G: GROWING HORTICULTURAL CROPS

PROBLEM AREA: GROWING GREENHOUSE FLOWERING CROPS FROM SEEDS AND CUTTINGS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with sophomores or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the fall and spring semesters. Crops grown from cuttings may include the chrysanthemum or poinsettia. Cool crops grown from seed might include the cineraria and calceolarias. Warm crops grown from seed and cuttings might include african violets and gloxinias. African violets and gloxinias may be grown under lights in the classroom by horticulture classes which do not have access to a greenhouse.

Worksheets for chrysanthemum production have been included in this problem area. These can be adapted by the teacher for other crops, such as, poinsettias, gloxinias, african violets, calceolarias and cineraria.

The estimated instructional time for this problem area is 10 to 20 days, depending on how far the teacher wishes to go in developing growing ability of flowering greenhouse crops at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be 4 days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, student worksheets, and test questions were developed by Ron Biondo, Department of Vocational and Technical Education, University of Illinois and Jim Ethridge, Joliet Junior College. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Field Test Teachers. The information sheets "Pot Mum Cultural Information" and "Designing A Pot Mum Program" were provided by the Ball Seed Company, West Chicago, IL.

TEACHER'S GUIDE

I. Unit: Growing horticulture crops

II. Problem area: Growing greenhouse flowering crops from seed and cuttings.

III. Objectives: At the completion of this problem area students will be able to:

1. Grow a chrysanthemum crop from cuttings.
2. Grow a poinsettia crop from cuttings.
3. Grow a cool crop, such as cineraria or calceolaria from seed.
4. Grow a warm crop, such as african violet or gloxinia from seed.
5. Identify cultural problems of various greenhouse flowering crops.

IV. Suggested interest approaches:

1. Bring into class several examples of the crop to be grown and discuss the ideal characteristics of the plants being shown.
2. Ask the students if they would like to raise funds for their FFA chapter by growing and selling flowering crops using the school greenhouse.
3. Present the following questions to the class:
    a. Is anyone interested in a career as a greenhouse worker or manager?
    b. Why is a career as a greenhouse worker attractive?
    c. Do you think a greenhouse worker's job is challenging?

V. Anticipated problems and concerns of students:

1. What crops should we attempt to grow in the school greenhouse?
2. What crops can be grown in the same environmental conditions?
3. How do I start a poinsettia and mum crop?
4. What size of container do I use in growing mums and poinsettias?
5. What soil media do I use in growing mums and poinsettias?
6. What type of container should one use when growing mums and poinsettias?
7. How many cuttings should I place in the container?

8. How are mums and poinsettias started?

9. What insects and diseases attack poinsettias and mums?

10. What cultural pests are likely to be a problem in the production of mums and poinsettias?

11. Which varieties of mums and poinsettias should I grow?

12. How are stock plants grown for cuttings?

13. How do I propagate new plants from stock plants?

14. When should poinsettias be planted for Christmas sales?

15. When should mums be planted?

16. How do I time or schedule a mum and poinsettia crop?

17. How should I prepare the plants for sale?

18. How do I calculate the cost of growing the poinsettia and mum crop?

19. What other flowering pot plants are grown?

20. What is the advantage of cool season or warm season pot plants in scheduling greenhouse use?

21. What temperatures are cool season and warm season crops grown?

VI. Suggested learning activities and experiences:

1. Discuss the effects of containers on the production of plants.

2. Have the students read the Information Sheet "Photoperiodism" and discuss photoperiodism in class.

3. Have the students complete the Worksheets "Chrysanthemum Culture" and "Chrysanthemum Scheduling Using the Information Sheets" "Pot Mum Cultural Information" and "Designing a Pot Mum Program." Additional reference can be made to pages 247-302 of the Ball Red Book.

4 Plant a chrysanthemum crop. Discuss the number of cuttings to be planted in each pot.

5. Schedule the crop to determine when it is to be ready to sale.

6. Keep a record book of observations and costs in the production of the crop.

7. Have the students complete the laboratory exercise "Growth Regulators."

8. Practice the skills of shading, pinching, lighting, application of chemicals, and the identification of pests.

9. Prepare plants for sale; discuss the cost of getting the plant ready for sale and how to cut these costs.

10. Discuss the final appearance of the crop with the students. What could have been done differently to produce a better crop.

11. Grow a poinsettia crop. Adapt the worksheets provided in this problem area to a poinsettia crop situation.

12. Have individual students make a survey of the crop being studied as to who is growing the crop in your local area. Also determine who is selling the crop in your local area. If possible, determine where the crops being sold are purchased. This will serve as a business experience to determine why the material is or is not being grown locally.

13. Have the students keep complete records on each crop grown by the class. Use the record book to compare with past class production records, as a performance evaluation, and teaching method to determine what the student is missing in their observations of the crop.

14. If time, space, and growing conditions permit, grow a warm season or cool season crop.

15. Provide the opportunity for students to grow greenhouse flowering crops for their S.O.E. programs.

VII. Application procedures:

1. Once the students have successfully grown a crop from cuttings; it should be possible for them to grow another of the same crop with greater success and sales desirability.

2. Once success has been achieved with a chrysanthemum crop; it should be possible for the class, and each individual to grow other crops using adapted techniques.

3. With the use of the problem area on the production of bedding plants and this problem area; it should be possible for the students to grow several flowering house plants from seed to sale. The production techniques learned in these two problem areas should be easily adapted.

4. The skills learned in the problem area should enable the student to be a better consumer in the selection of plant material for others, as a retail sales clerk.

5. Information in the problem area will assist the student in making a decision about career choices in the area of the production greenhouse.

VIII. Evaluation:

1. Prepare and administer an objective paper and pencil test covering the material presented and discussed in this problem area.

2. Evaluate worksheets and record books completed by the students:

3. Conduct a practical performance test using the crops grown by the students.

IX. References and aids:

1. University of Illinois, Vocational Agriculture Service. Subject Matter Units.

   #5011 "Poinsettias Care and Propagation"
   #5013 "Producing Poinsettias Commercially"

2. "Commercial Poinsettia Production", The North Carolina Agricultural Extension Service, Circular AG 108

3. 13th Edition of the Ball Red Book, Geo. J. Ball, Inc. pp 223, 224, 246, 302, 342, 402, 434, 455.

4. Production catalogs from business firms that sell chrysanthemum and poinsettia cuttings.

5. Student worksheets:

   a. "Mum Culture"
   b. "Mum Scheduling"

6. Information sheets included in this problem area:

   a. "Photoperiodism"
   b. "Desiging a Pot Mum Program"
   c. "Pot Mum Cultural Information"

7. Ohio Florist Association Bulletin No. 610 August 1980 "1980 Poinsettia Production Costs.

8. Growing Container Plants. "A Guide to Production in the High School Greenhouse" by Denise Hughes and Laura Williams, Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407.

9. Ecke Poinsettia Manual, Encinitas, CA, 92024, (714) 753-1134.

INFORMATION SHEET

PHOTOPERIODISM
(period of light)

Definition: The effect of the amount of light per day on the growth of plants.

Plants can be classified into 3 groups:

1. short day plants
2. long day plants
3. day-neutral plants

SHORTENING THE DAY: To obtain the short day effect, the night period must be uninterrupted; a short day plant, could also be called a long-night plant.

A short day plant must have 12-14 hours of uninterrupted darkness in order to produce flower buds.

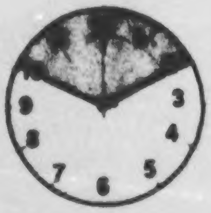
Lights in the immediate area outside the greenhouse may interrupt the night period. Black sateen cloth or heavy black plastic can be used to insure total darkness. The amount of light given off from a flashlight, is strong enough to interrupt the night period.

(examples of short-day plants: mums, poinsettias, kalanchoe)

LENGTHENING THE DAY: Provides a long day for promoting the flowering of long-day plants or maintaining the vegetable growth of short-day plants.

Some long-day plants can be matured earlier if they are lighted. Calceolarias and many annuals will flower earlier if lighted.

To prevent bud formation in short-day plants and encourage vegetable growth, short-day plants must be lighted. The number of lighted days depends on the crop.



DAY NEUTRAL PLANTS: Plants will flower regardless of the day length. No beneficial effects will be seen either from using supplemental light or shortening the day.

INFORMATION SHEET

DESIGN A POT MUM PROGRAM FOR YOUR MARKET[*]

Container Size	Plants Per Pot	Close Spacing	Finishing Spacing	Ideal Height	Adjust Long Day
4 in.	1	4x5 in.	7x7 to 8x9 in	8-10 in.	-1 week
5 in.	2-3	5x6 in.	10x10 to 12x12 in.	10-12 in.	-½ week
6 in.	4-5	6x7 in.	12x12 to 14x14 in.	16-18 in.	Schedule
7 in.	5-6	7x8 in.	14x14 to 16x18 in.	18-20 in.	+½ week
8 in.	6-8	8x10 in.	16x16 to 20x20 in.	18-22 in.	+1 week

Complete listing of varieties and cultural information available on request. Contact your Ball representative or write us.

POT-MUM SCHEDULE

Long-day weeks for 6 inch pots would be:

	Summer	Spring/Fall	Winter
Tall varieties	0	1	2
Medium varieties	1	2	3
Short varieties	2	3	4

Southern growers: Do not use winter timing. Sufficient long-day time is important! Add long-day weeks to response weeks to get total crop time, and flower or plant dates can be calculated accordingly.

DISBUDDING POT MUMS FOR MARKET APPEAL - 4 DISTINCT METHODS

1. Disbudding. Remove all buds on each stem, leaving terminal bud only.

2. Center Bud Removal (C.B.R.) Done on many daisy varieties and small pot production. Terminal bud removed.

3. Multiple Bud Removal (M.B.R.). Done earlier. Similar to C.B.R. A soft pinch is made when buds can be felt and not yet seen.

4. Non-Disbudding. Allow all buds to flower.

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[*] Courtesy of Ball Seed Company, West Chicago, Illinois

LIGHTING MUMS

10 fc or 1¼ watts per sq. ft. June and July: 2 hours nightly.
April, May, August and September 3 hours nightly.
October-March: 4 hours nightly.
60-W bulbs, 2½-ft high 4 ft. apart.
100-W bulbs, 4½ ft. high, 6 ft. apart.
150-W bulbs, 6 ft. high, 10 ft. apart.

SHADING MUMS

For 13 hours nightly, from start of short-day date to showing of color. March 15 to September 15 each year.

Temperatures for Pot Mums

	Night	Day	Vent
Starting area	62-64°	66-68°	70-74°
Growing area	60-62°	64-66°	68-70°
Finishing area	58-60°	62-64°	64-66°

RETARDING STRETCH WITH B-NINE

Use 2500 ppm during winter
3750 ppm spring and fall
5000 ppm during summer

Usual treatment is:

Tall varieties: both applications.
Medium varieties: first application only.
Short varieties: second application only.

Apply to run-off when breaks are 2-2½ inches long.
A second application may be made 14 days later, if needed.

Super-tall and single stem preplant dip at 2500 ppm concentration.

PARTIAL LIST OF POT MUM VARIETIES	Response	Color	Type	Season	DISBUDDING Disbud	DISBUDDING C.B.R.	PINCHED 4-inch	PINCHED 6-inch	Single Stem
WHITE									
Illini Sparker (Pat 4217)	8 medium	Pure white	Daisy	W/Sp/S/F	X			X	
Alpine (Pat Pend.)	9 tall	White	Decorative	W/Sp/S/F	X			X	
Free Spirit (Pat. Pend.)	9 medium	Pure white	Quilled	W/Sp/S/F	X	X	X	X	
Neptune	9 short	Pure white	Decorative	W/Sp/S/F	X	X	X	X	
Ruffled Spirit (Pat. Pend.)	9 medium	Pure white	Novelty	/Sp/S/F	X	X	X	X	
YELLOW									
Fiesta (Pat. 3632)	8 tall	Yellow	Daisy	W/Sp/S/F		X	X	X	
Gettysburg (Pat. Pend.)	9 medium	Yellow	Daisy	W/Sp/S/F		X	X	X	
Ritz (Pat. 3863)	9 short	Yellow	Daisy	W/Sp/S/F		X	X	X	
Yellow Torch (Pat. 3421)	9 short	Yellow	Decorative	/Sp/S/F	X	X	X	X	
Bright Golden Anne	10 tall	Yellow	Decorative	W/Sp/ /F	X			X	X
Goldstar (Pat 3213)	10 medium	Yellow	Decorative	/Sp/S/F	X		X		
Mountain Peak (Pat. 3458)	10 medium	Yellow	Decorative	/Sp/S/F	X		X	X	X
Sunburst Spirit (Pat. Pend.)	10 medium	Yellow	Quilled	/Sp/S/F	X	X	X	X	
Yellow Mandalay	10 medium	Yellow	Decorative	W/Sp/S/F	X	X	X	X	
PINK									
Anthem (Pat. Pend.)	9 tall	Pink	Daisy	W/Sp/S/F		X	X	X	
Loyalty (Pat. 4289)	9 medium	Pink	Decorative	W/Sp/S/F	X	X	X	X	
Princess Anne Superb	10 tall	Pink	Decorative	W/Sp/ /F	X			X	X

PARTIAL LIST OF POT MUM VARIETIES	Response	Color	Type	Season	DISBUDDING Disbud	C.B.R.	PINCHED 4-inch	6-inch	Single Stem
BRONZE									
Amber Concord (Pat. 4311)	9 tall	Light bronze	Daisy	W/Sp/S/F		X	X	X	
Copper Hostess (Pat. 4092)	9 medium	Bronze	Decorative	W/Sp/S/F	X	X	X	X	
Minuteman (Pat. 3832)	9 medium	Bronze	Decorative	/Sp/S/F	X	X	X	X	
Red Torch (Pat. 3263)	9 short	Red	Decorative	W/Sp/ /F	X	X	X	X	
Cooper Anne	10 tall	Orange bronze	Decorative	W/Sp/ /F	X			X	X
Cooper Bowl	10 short	Orange	Decorative	/Sp/S/F	X	X	X	X	
Crimson Anne (Pat. Pend.)	10 tall	Red	Decorative	W/Sp/ /F	X			X	
Mandalay	10 medium	Light bronze	Decorative	W/Sp/S/F	X	X	X	X	

Whenever possible, order one group only! Short! Medium! or Tall!

INFORMATION SHEET

POT MUM CULTURAL INFORMATION*

1. Media should be well draining! Soil, peat and perlite or vermiculite mixed in equal parts will do well. Many growers are using mixes such as Ball Growing Mix II.

2. Containers are as a rule azalea pots. Should have drainage holes in the bottom. 5" and up, side drainage as well. Opaque material is better than translucent.

3. Plants must be of the highest quality for best performance. Grade for evenness.

Pot Size	No. of Plants	Close Spacing	Finishing Spacing	Long Day
4"	1	4x5"	7x7 to 8x9	-1 week
5"	2-3	5x6"	10x10 to 12x12	-½ week
6"	4-5	6x7"	12x12 to 14x14	Schedule
7"	5-6	7x8"	14x14 to 16x16	+½ week
8"	7-8	8x10"	16x16 to 20x20	+1 week

4. Spacings are often as a guide only! Number of plant used will vary by variety, season and the spacing selected.

5. Lighting starts at planting, and ends when short days start. Recommended duration:
   2 hours nightly during June and July
   3 hours nightly during April-May and August-September
   4 hours nightly during October through March

   Intensity should be 10 ftc. or 1¼ Watts per square foot minimum.

6. Long day treatment is used at the beginning of the crop, plants are lighted to keep them vegetative and allow them to get established and develop growth.

Tall varieties	get 0 weeks of long days March 1 - September 15, and 1 week of long days Sept. 15 - March 1
Medium varieties	get 1 week of long days March 8 - September 8, and 2 weeks of long days Sept. 9 - March 8
Short varieties	get 2 weeks of long days March 15 - September 15, and 3 weeks of long days Sept. 15 - March 15

7. Pinching is done best when 1½" of new growth has developed. At this time, a 3/4" tip pinch is made. Do not pinch too soon!

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*Courtesy of Ball Seed Company, West Chicago, Illinois.

8. Short day treatment or blackout shading is used following the long day period to initiate and develop buds. Shade nightly from March 15 to September 15, all material not being lighted and not showing color. 7:00 PM to 8:00 AM is best!

9. Growth Retardants are used to keep crop short. We recommend the use of B-9 as follows: 1 lb. of B-9 in 2 gallons of water = 50,000 ppm (5%). This is stock solution.

1 part stock solution to 19 parts of water = 2,500 ppm
1 part stock solution to 14 parts of water = 3,7500 ppm
1 part stock solution to 9 parts of water = 5,000 ppm
Dilute: 6.3 oz of stock solution in one gallon of water = 2,500 ppm
9.6 oz of stock solution in one gallon of water = 3,750 ppm
12.6 oz of stock solution in one gallon of water = 5,000 ppm

Most effective time of application is when breaks are 2-2½" long. Tall varieties will benefit from a second application 14 days after the first. B-9 sensitive varieties should have one late application only. Concentrations may be used as follows:

Winter 2,500 (November-February)
Spring/Fall 3,750 (Sept/Oct. + Mar./Apr.)
Summer 5,000 (May-Aug.)

In southern locations, 3,750 may be used fall, winter and spring.

10. Temperatures:

	Night	Day	Ventilate
Starting Area	62-64°	66-68°	70-72°
Growing Area	60-62°	64-66°	68-70°
Finishing Area	58-60°	62-64°	64-66°

11. Feeding is best done on a constant basis! 250 ppm of 20-20 is 1 lb. of 20-20 per 100 gallons of water, or per 1 gallon of stock solution for a 1:100 injector. 8 oz. of postassium nitrate plus 8 oz of ammonium nitrate per 100 gallons of water or 1 gallon of stock solution (1:100) will make good growing on feed, year round in the South and March to September in the North. 8 oz of potassium nitrate plus 16 oz. of calcium nitrate per 100 gallons of water or per gallon of stock solution (1:100) will make an excellent winter feed. Reduce feed about one week before disbudding. This is best done by alternating one feeding with one watering.

12. Disbudding is done about 3 weeks before shipping. All side buds are removed!

Center Bud Removal is done on most daisy varieties. Remove center bud only! Flowering delay is one week!

Multiple Bud Removal is done when breaks are 3½" to 4" long. When the bud can be felt but not yet seen, a soft pinch is made. This will remove several buds and open up clubby spray varieties. Flowering delay is minimal.

WORKSHEET

CHRYSANTHEMUM CULTURE

Greenhouse mums can be grown as a crop in benches or in pots. Mum varieties should be chosen by how they will be grown.

...Varieties differ by flower color, disease resistance, hardiness, leaf color and shape etc.

FLOWER TYPES:

1.
2.
3.
4.
5.
6.

BENCH CROPS CAN BE GROWN AS....

1. ______________________

One large flower per stem; all lateral buds removed or ____________________.

2. ______________________

Many flowers per stem, soft-pinched with about 30" stem.

PROPAGATION: Growers usually purchase rooted cuttings that are ______________ inches in length.

SOIL MIX: _____ - _____ - _____

What are the characteristics of the soil?

1.

2.

3.

POTTING AND SPACING: Keep newly transplanted cuttings __________. Plant ______________ for faster root establishment. Space on the benches as needed to prevent leaves from touching, increase air circulation and allow plenty of light between plants.

LIGHT: A ____________-day plant. A ______________ plant results from low-light intensity or poor spacing practices.

TEMPERATURE: __________ night __________ day.

FERTILIZER: ____ - ____ - ____

These numbers represent the amounts of ______________ - ______________ - ______________. With a greenhouse crop, use a constant feed program.

DISEASES:

1. ______________________

   Causes:

   1.
   2.
   3.

2. ______________________

   Causes:

   1.
   2.

INSECTS: ____________________ and ______________________.

SCHEDULING AND TIMING: Mums can be grown year-round using artificial lighting and shading. Varieties must be chosen carefully, for most have been developed for specific growing seasons.

NEW TERMS

disbud
lateral bud
terminal bud
constant feed
standard
spindly
bench crop
potted crop
spray

NOTES:

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WORKSHEET

CHRYSANTHEMUM SCHEDULING

A horticulture class wants to grow a crop of mums to bloom for Memorial Day, May 30th. Unfortunately, they can't decide when to plant, pinch or shade the crop. Can you help them? They are interested in using a 9 week, medium treatment variety.

1. potting date

2. pinching date

3. shading date

The class is working with a limited area of growing space, so it is important that they don't order too many cuttings. If they have 6 benches that measure 5' x 10', how many 6" pots can be grown with a 15" x 15" spacing? How many cuttings should they purchase in order to have 5 cuttings per pot?

LABORATORY EXERCISE

GROWTH REGULATORS

NOTE: The entire area of commercial growth regulators is relatively new. Although the chemicals that have been used for weed control could be considered as growth regulators, the materials normally thought of are those that will alter the growth pattern of the plant without producing harmful effects, or will not destroy the commerical value of the plants. Before a chemical can be labeled as a growth regulator, much research must be done to determine the groups of plants on which the chemicals will have the desired effect. Some chemicals will have the desired effects on certain plants but not on others. This research, as well as research to determine the correct concentration and the method of application, is conducted before the chemical is marketed, but variations of this research may develop after the chemical has been in use. The two most widely accepted methods of application at this time are soil drenches and foliar sprays. You will notice in this demonstration that the chemical Cycocel (CCC) is best used as a soil drench, while B-Nine is best used as a foliar spray.

I. Objective:

1. To develop the ability to use correctly various plant growth regulators.
2. To develop an understanding of the effect of these chemicals on plant growth.
3. To develop an understanding of scientific methods of observation and procedure.

II. Materials needed:

1. Flasks for mixing the chemicals.
2. Graduate cylinders for making up the proper proportions of the chemicals.
3. Small, liter or quart-sized sprayers for applying chemicals to the plants.
4. A powder detergent, such as Tide, or a spreader, such as Tween-20.
5. Growth regulating chemicals.*
    a. B-Nine (N-dimethylaminosuccinamic acid)
    b. Cycocel (CCC) (2-Chloroethyl trimethylammonium chloride)

6. Plants.

   a. Poinsettia - two to four-week-old plants for rooted cuttings.

   b. Chrysanthemum - three-week-old plants from rooted cuttings.

   c. Petunia - six-leaved stage seedlings.

   d. Geranium - two-week-old plants from rooted cuttings.

III. Procedure:

1. To observe the effect of a chemical and the various concentrations of that chemical on plant growth, a number of treatments should be set up to demonstrate the effect of each chemical on each species of plant. An example using the Poinsettia follows (the same procedure may be used for each of the species to be tested):

Plant Poinsettia	No. of Plants Treated	Chemical	Concentration	Method of Application	Ml. of Solution to Apply to each Plant
	3	Cycocel	10^2	Soil Drench	200 ml./6-in. pot
	3	Cycocel	3×10^2	Soil Drench	200 ml./6-in. pot
	3	Cycocel	10^2	Foliar Spray	**See Footnote
	3	Cycocel	3×10^2	Foliar Spray	**See Footnote

2. Repeat the procedure using B-Nine as a foliar spray and a soil drench at 2500 and 5000 parts per million and compare the action of the two chemicals on all plants. Wet the leaves until the solution runs off.

3. Commercially, there are several ways of applying these chemicals. Follow the list of times recommended at the beginning of this demonstration. It is recommended that the cuttings or seedlings be well rooted and be in the container or bench where they are to remain for either the remainder of their growing period or until they are to be transplanted when they are larger and more mature.

4. Record the results of the demonstration in a manner similar to the chart below. As noted, the effect of the chemical varies, depending on the plant, the concentration of the chemical, and the method and time of application. An interesting experiment would be to determine at what stage of growth the chemicals are most effective.

Plant	Chemical Most Effective	Chemical Conc. Most Effective	Best Method of Application	Best Time of Application
Poinsettia				
Chrysanthemum				
Geranium				
Petunia				

IV Application:

Growth regulators are used in the greenhouse for many different purposes. One of the most common uses is to cause poinsettia plants to grow short stems so that a relatively low-growing, compact plant results. This makes the plant more desirable for table decoration at Christmastime. Growth regulators may also be used to cause plants to grow unusually tall and to change their shape and density.

Growth regulators may be thought of as being organic compounds which will promote or slow down growth or affect other physiological processes in plants. The results discovered in this demonstration are only a few that are known. There are undoubtedly many others that are yet to be discovered because of the newness of the use of these chemicals. In the future, the use of growth regulators will increase and thus many processes now employed commericially to change growth patterns of plants will either be modified or completely eliminated. Some of the advantages that may result will prove to be very profitable to the producer.

IV. Observations:

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

GROWING GREENHOUSE FLOWERING CROPS

Multiple Choice

C 1. ____________ are examples of short day plants.

- a. Annuals
- b. Calceolarias and Poinsettias
- c. Chrysanthemums and Poinsettias
- d. Calceolarias and Chrysanthemums

A 2. A short day plant needs ________ hours of uninterrupted darkness in order to produce flowers.

- a. 12-14
- b. 6-8
- c. 10-12
- d. 14-16

D 3. A good media for chrysanthemum growth is ________.

- a. 1/3 soil 2/3 sand
- b. 1/3 soil 2/3/ perlite
- c. 1/3 peat 1/3 perlite 1/3 sand
- d. 1/3 soil 1/3 peat 1/3 perlite

C 4. The most commonly used containers for chrysanthmum production are ____________.

- a. standard pots
- b. bulb pots
- c. azalea pots
- d. peat pots

D 5. ____________ chrysanthemum cuttings may be placed in a 6" pot.

- a. 5-6
- b. 2-3
- c. 3-4
- d. 4-5

A 6. Temperatures are warmest in the ________ stage of growth.

- a. starting
- b. growing-on
- c. finishing

A 7. Fertilizing is best done on __________.

a. constant basis
b. every other watering
c. the first day of planting
d. the day before sale

B 8. Disbudding is the removal of __________.

a. center buds
b. side buds
c. vegetative buds
d. latent buds

B 9. Generally, poinsettia stock plants are received as rooted cuttings in __________.

a. late winter
b. early spring
c. summer
d. at any time of the year

B 10. The critical day length for poinsettias is __________.

a. 11 hours 30 minutes
b. 12 hours 15 minutes
c. 10 hours
d. 14 hours 15 minutes

D 11. Poinsettias are pinched to __________.

a. reduce water transpiration
b. control height and reduce branching
c. darken the leaf color
d. control height and produce branching

B 12. The most common growth regulator used with poinsettias is __________.

a. A-rest
b. cycocel
c. B-Nine
f. auxin

C 13. Cineraria seed is sown in __________.

a. April and May
b. June and July
c. August and September
d. February and March

B 14. Cineraria will not set flower buds if temperatures are above ____________________.

a. 50 F
b. 60 F
c. 70 F
d. 80 F

A 15. Calceolarias are usually grown from ____________________.

a. seeds sown in September
b. leaf cuttings taken in November
c. seeds sown in May
d. stem cuttings taken in May

D 16. Calceolarias do very well in night tempratures of _______.

a. 62 to 64°F
b. 56 to 60°F
c. 42 to 46F
f. 48 to 50F

D 17. African violets may be produced ____________________.

a. by seed only
b. by leaf cuttings only
c. by crown cuttings only
d. all of the above

D 18. Gloxinias are related to ______________.

a. Cinerarias
b. Poinsettias
c. African Violets
d. Calceolarias

B 19. Gloxinias are an example of ____________________.

a. day-neutral plants
b. warm season plants
c. cool season plants
d. short day plants

A 20 What's the advantage of growing cool and warm crops in the greenhouse?

a. The greenhouse can be utilized year-round.
b. They require little to no planning.
c. They are tough and withstand adverse conditions.
d. All of the above.

UNIT G: GROWING AND MANAGING HORTICULTRAL CROPS

PROBLEM AREA: GROWING CONTAINER NURSERY CROPS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with sophomores or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the spring semester.

The estimated instructional time for this problem area is 5-10 days, depending on how far the teacher wishes to go in developing skills in growing container nursery stock at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be 3 days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, student worksheet, transparency discussion guide, and test questions were developed by Jim Ethridge, Joliet Junior College and Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Transparency masters were prepared by the Vocational Agriculture Service, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Field Test Teachers.

TEACHER'S GUIDE

I. Unit: Growing and managing horticultural crops

II. Problem area: Growing container nursery crops

III. Objectives: At the completion of this problem area students will be able to:

1. Identify tools, equipment, containers, and materials normally used in the growing of container nursery stock.
2. Identify the American Nursery Standards for quality nursery stock.
3. Demonstrate the proper transplanting of nursery stock from one container to another.
4. Describe and perform the proper way to water container nursery stock.
5. Describe and perform the proper mixing and application of fertilizers to container nursery stock.
6. Use pruning tools correctly and to perform the operation on container nursery stock, depending on the variety of the plant and its future use in the landscape.

IV. Suggested interest approaches:

1. Discuss container nursery stock being grown in Florida (house plants) and container nursery stock being grown in Illinois. Note their similarities.
2. Discuss how may plants can be grown per acre in an "in field" nursery vs how many of the same plant that can be grown in containers in the same locations.
3. Bring a container plant and a balled and burlapped plant to class and ask what are the advantages of each.

V. Anticipated problems and concerns of students:

1. When is a house plant a container nursery plant?
2. Where should a container nursery be located?
3. What is a cycle of production for a container nursery plant?
4. How are container nursery stock plants watered?
5. What plants are grown as container nursery stock in Illinois?

6. What size of container should be used?
7. What size of plant should be grown?
8. What soil mix should be used in growing container nursery stock?
9. How is a nursery plant "canned?"
10. How is a growing bed established?
11. How are container nursery plants overwintered?
12. How are nursery plants pruned or sheared in the container nursery?
13. How are weeds controlled in container nurseries?
14. What trade associations are available to container nursery growers?
15. What watering systems are used in container nurseries?
16. At what spacings should container nursery stock be placed?
17. What kind of container should be used in the container nursery?

VI. Suggested learning activities and experiences:

1. Have students remove plants from selected metal, plastic and fiber containers and discuss why the root systems developed differently and how approved practices for care will vary depending on the type of container that is used.
2. Show Vocational Agriculture Service Slidefilms 684 "Container Production of Nursery Stock" and 690-2 "Soils for Plant Growth: Container Soils."
3. Have students "can" different types of cuttings into containers and also have them "put up" plant material from one size of container to another. Discuss the method of planting with the students.
4. Have students grow the same type of plants in different kinds of containers and note the difference in growth.
5. Have students price different types of containers.
6. Have students visit various nurseries to see what types of containers are being used most.

7. Have students draw a plan for a nursery layout.

8. Use different types of stakes and tying materials for container stock and field-grown stock.

9. Practice controlling insects, pests and diseases using as many different controls as possible.

10. Have students bring samples of plants with insect or disease damage and try to identify and diagnose possible treatments.

11. Propagate woody nursery stock commonly growing in containers and establish a container nursery in your land laboratory.

12. If students have space available at home; have interested students begin an S.O.E.P. with container nursery stock. One gallon container nursery stock is an excellent beginning. Several hundred can be grown in a very small space.

13. Have individual students visit a local garden center and determine what types of nursery stock can be grown in containers.

13. For those students interested in learning about container nursery stock but unable to have plants at home; establish a location on the school grounds where they might be able to have their individual S.O.E.P.

VII. Application procedures:

1. Once the students have successfully grown a container nursery crop from cuttings; it should be possible for them to grow another of the same crop with greater success and sales desirability.

2. The skills learned in the problem area should enable the student to be a better consumer in the selection of plant material for others, as a retail salesclerk in a garden center.

3. Information in the problem area as it relates to the keeping of SOE records will assist the student in making a decision about career choices in the area of the container nursery production.

VIII. Evaluation:

1. Prepare and administer an objective paper and pencil test covering the material presented and discussed in this problem area.

2. Evaluate worksheets completed by the students; as well as their record books.

3. Conduct a practical performance test using the crops grown by the students.

IX. References and aids:

1. Nursery Management, Administration and Culture, Harold Davidson and Roy Mecklenburg, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, pp 222-231, 248-252, 260-275, 26, 16, 25, 88, 90, 12.

2. Vocational Agriculture Service Slidefilms

684	"Container Production of Nursery Stock" 66 Frames
690-2	"Soils for Plant Growth: Container Soils" 42 Frames

3. "American Nurseryman Magazine," January 15, 1982 Container Production Issue.

4. Information Sheets included in this problem area:

   a. "Container Grown Nursery Stock"
   b. "Nursery Plants Grown in Containers"
   c. "Determination of Air Filled Pore Space for Container Grown Nursery Stock"
   d. "Container Stock Crop Schedule"

5. Transparencies and Transparency Discussion Guide.

INFORMATION SHEET

CONTAINER GROWN NURSERY STOCK

I. Container Grown Nursery Stock -- Within the past few years the popularity of container grown nursery stock has increased manyfold. It first started in California because land was so expensive and water was scarce. At the present time 90% of the nursery stock grown in California is grown in containers. In the southeast approximately 50% is container grown, and at the present only 5-10% is container grown in Illinois and the mid-west. With more recent advancements in storage and growing techniques, container growing is rapidly on the increase. The reason for this increase is the high cost of land, scarcity of labor, prolonged planting season, mass merchandising, etc.

II. Advantages of container growing:

a. more concentrated (less land)
b. ease of handling
c. light in weight
d. standardized growing methods
e. prolonged planting season
f. higher degree of survival (no loss of root system)
g. less labor per plant (no digging)
h. more adaptable to mass merchandising

III. Disadvantages:

a. higher cost per acre
b. more winter injury
c. length of time in container limited
d. size restriction
e. more technology required

IV. Difficulties encountered:

a. poor soil mixes
b. poor watering
c. poor fertilization
d. inadequate spacing

V. Types of containers:

a. used cans
b. plastic pots
c. styrofoam pots
d. new cans
e. baskets
f. boxes
g. wire frames
h. paper pots
i. color of containers should be light to reflect heat

VI. Watering:

a. Types of Systems:

1. hand
2. sprinkler (overhead or mist)
3. plastic tubes (capillary tubes) or Chapin System

b. Frequency of Watering Depends on:

1. Temperature--The warmer it is, the more often the container needs water.
2. Types of soil mix--the more porous the soil, the greater the amount of water needed.
3. Size of containers--The larger the container, the greater the amount of water needed at each watering. Smaller containers usually dry out more quickly, however.
4. Materials from which the containers were constructed--clay pots dry faster than cans or plastic pots.
5. Size of plant--The larger the plant the more rapidly water is used.
6. Kinds of plants
7. Season of the year--plants grow faster in spring and summer, and require more water at that time.

VII. Fertilization:

a. Factors to consider when fertilizing:

1. Type of plant--some plants need more fertilizer than others. Some respond better to either liquid or dry fertilizer.
2. Type fo soil mix--
Heavier soils hold nutrients longer, so fertilizer is needed less often.

Watering tends to leach out nutrients, so if plants have been irrigated heavily, additional fertilizer may be needed.

b. Dry fertilizers
c. Slow release fertilizers
d. Liquid injection:

1. Smith injector
2. Gewa injector
3. Ferto jet
4. Venturie System

e. Rates of injection:

From 1-50 up to 1-300, but 1-200 is the most popular one used. Below 1-50, dilution foliage burn will occur and above 1-300, the solution is too weak.

f. Concentration is based on ppm of actual nitrogen and varies from 150 as a low, up to 300 as a high. To figure ppm take the percentage of N of water soluble fertilizer and multiply by 75. This equals what one ounce of fertilizer will give in ppm if placed in 100 gallons of water.

Example: 20-20-20 analysis

.20 × 75 = 15

1 ounce of a 20-20-20 fertilizer in 100 gallons of water = 15 ppm.

To determine how much to increase this to 200 ppm, divide 200 by 15 = 13.33 oz. To obtain a solution of 200 ppm using a 20-20-20 analysis, you add 13.33 oz. of 20-20-20 to each 100 gallons.

IX. Staging:

a. Asphalt - is dark, builds up heat and deteriorates when fertilizer is used.

b. Black plastic - holds weeds down but builds up heat.

c. Gravel - good but weeds grow through, so place black plastic underneath.

X. Winter Protection:

a. Stage close together and mulch with straw, bank or other mulch material

b. Cover with plastic (See Orn. Hort. Reports by U.I. 1968)

c. Killing Temperatures of common ornamental container stock:

Plant	Safe Temperature		Killing Temperature	
Saucer Magnolia	26°F	--3.5°C	23°F	--5.0°C
Star Magnolia	26	--3.5	23	--5.0
Flowering Dogwood	24	--4.5	20	--6.5
Convexleaf Japanese Holly	24	--4.5	20	--6.5
American Holly	24	--4.5	18	--7.8
Rockspray	22	--5.5	18	--7.8
Scarlet Firethorn	22	--5.5	18	--7.8
Creeping Cotoneaster	20	--6.5	16	--9.0
Koreanspice Viburnum	20	--6.5	15	--9.5
Purpleleaf Japanese Maple	17	--8.5	14	-10.0
AngloJap Yew	15	--9.5	10	-12.3
Hinodegiri Azalea	15	--9.5	10	-12.3
Moutain-Laurel Kalmia	15	--9.5	*	*
Drooping Leucothoe	15	--9.5	*	*

Plant	Safe Temperature		Killing Temperature	
Oregongrapeholly	15	--9.5	*	*
Japanese Pieris	15	--9.5	*	*
Catawba Rhododendron	15	--9.5	*	*
Eastern Arborvitae	15	--9.5	*	*
Wintercreeper Euonymus	10	-12.2	5	-15.0
Andorra Juniper	10	-12.2	0	-17.8
Waukegan Juniper	10	-12.2	0	-17.8
Rhododendron 'PJM'	10	-12.2	0	-17.8

*Not determined

INFORMATION SHEET

CONTAINER STOCK CROP SCHEDULES

This schedule indicates the size of plants (in inches across the top), size of container, and production time for groups of container-grown nursery stock produced in Northeastern United States.

Plant Group*	Size Plant (top diameter)	Size Container**	Production Time, Years
Small deciduous trees	12-15" (height)	6" can	2
	15-18" (height)	6" can	2
	18-24" (height)	8" can	3
	2'-3' (height)	8" can	3
Narrowleaved evergreen shrubs	9-12"	6" can	1
	12-15"	6" can	2
	15-18"	8" can	2
	18-24"	10" can or 1 peck basket	2
Large broadleaved evergreen shrubs	10-12"	6" can	1
	12-15"	6" can	1
	15-18"	1 peck basket	2
	18-21"	1 peck basket	2
	21-24"	1 peck basket	3
	24-30"	½ bu. basket	3
	30-36"	½ bu. basket	4
	36-42"	½ bu. basket	4
Medium deciduous shrubs	12-15"	8" can	2
	15-18"	8" can	2
	18-24"	8" can	2
	24-30"	10" can	3
Medium broadleaved evergreens	12-15" (height)	8" can	2
	15-18" (height)	8" can	2
	18-24" (height)	8" can	3
	24-30" (height)	10" can	3
Small deciduous shrubs	9-12"	6" can	2
	12-15"	6" can	2
	15-18"	6" can	3
	18-24"	8" can	3
Small broadleaved evergreen shrubs	12-15"	6" can	2
	15-18"	8" can	3
	18-24"	8" can	3

Plant Group*	Size Plant (top diameter)	Size Container**	Production Time, Years
Deciduous and evergreen vines	12-15" (height)	6" can	1
	15-18" (height)	6" can	1
	18-24" (height)	6" can	2
	24-36" (height)	6" can	2
Deciduous and evergreen groundcovers	12-15"	6" can	1
	15-18"	6" can	2
	18-24"	6" can	2
Garden flowers, herbaceous perennials		6" can	1

*Examples of names of plants within each group are given in Information Sheet "Nursery Plants Grown in Containers"

**6" can equals approx. 1 gallon; 8", 2 gal.; 10", 5 gal.; and 1 peck, 4 gal.

Courtesy of Joliet Junior College Agriculture Department

INFORMATION SHEET

NURSERY PLANTS GROWN IN CONTAINERS

Common Name	Botanic Name
A. Small Deciduous Trees	
1. Bloodleaf Japanese Maple	Acer Palmatum 'Atropupureum'
B. Evergreen Trees	
1. Sawara Falsecypress	Chameacyparis pisifera
2. American Holly	Ilex opaca
3. Eastern Redcedar	Juniperus virginiana
4. Koster Blue Spruce	Picea pungens 'Glauca Koster'
5. Canada Hemlock	Tsuga canadensis
C. Narrowleaf Evergreen Shrubs	
1. Slender Hinoki Falsecypress	Chamaecyparis obtusa 'Gracilis'
2. Pfitzer Juniper	Juniperus chinensis 'Pfitzeriana'
3. Creeping Juniper	Juniperus horizontalis
4. Andorra Juniper	Juniperus horizontalis 'Plumosa'
5. Dwarf Mugho Pine	Pinus mugo Var. Mugo
6. "Ware's" Arborvitae	Thuja occidentalis 'Warenana'
D. Large Broadleaf Evergreen Shrubs	
1. Japanese Aucuba	Aucuba japonica
2. Common Box	Buxus sempervirens
3. Common Camellia	Camellia japonica
4. Evergreen Euonymus	Euonymus japonica
5. American Holly	Ilex opaca
6. Chinese Photinia	Photinia serrulata
7. Rhododendron	Rhododendron cultivars

E. Medium Deciduous Shrubs

1.	Mentor Barberry	*Berberis mentorensis*
2.	Japanese Barberry	*Berberis thunbergi*
3.	Redosier Dogwood	*Cornus stolonifera*
4.	Spreading Cotoneaster	*Cotoneaster divaricata*
5.	Winged Euonymus	*Euonymus alatus*
6.	Forsythia, "Lynwood Gold," "Spring Glory," "Beatrix Farrand"	*Forsythia intermedia* 'Spectabilis'
7.	Beautybush	*Kolkwitzia amabilis*
8.	Winter Honeysuckle	*Lonicera fragrantissima*
9.	Northern Bayberry	*Myrica pensylvanica*
10.	Flame Azalea	*Rhododendron calendulaceum*

F. Medium, Broadleaf Evergreen Shrubs

1.	Japanese Aucuba	*Aucuba japonica*
2.	Wintergreen Barberry	*Berberis julianae*
3.	Evergreen Euonymus	*Euonymus japonica*
4.	Spreading Euonymus	*Euonymus kiautschovicus*
5.	Convexleaf Japanese Holly	*Ilex crenata* 'Convexa'
6.	Burford Chinese Holly	*Ilex cornuta* 'Burfordi'
7.	Japanese Pieris	*Pieris japonica*
8.	Laland Firethorn	*Pyracantha coccinea* 'Lalandi'

G. Small Deciduous Shrubs

1.	Rockspray Cotoneaster	*Cotoneaster horizontalis*
2.	Dwarf Winged Euonymus	*Euonymus alatus* 'Compacta'
3.	Tree Peony	*Paeonia suffruticosa*
4.	Mollis Azalea	*Rhododendron kosterianun*
5.	Exbury Azalea	*Rhododendron hybrid*

6.	"Anthony Waterer" Spirea	*Spirea* *bumalda* 'Anthony Waterer'
7.	Dwarf European Cranberrybush Viburnum	*Viburnum* *opulus* 'Nanum'
8.	"Bristol Ruby" Weigela	*Weigela* 'Bristol Ruby'

H. Small, Broadleaf Evergreen Shrubs

1.	Glossy Abelia	*Abelia* *grandiflora*
2.	Korean Littleleaf Boxwood	*Buxus* *microphylla* 'Koreana'
3.	Somerset Daphne	*Daphne* *somerset*
4.	Bigleaf Wintercreeper Euonymus	*Euonymus* *fortunei* 'Vegetus'
5.	Evergreen Candytuft	*Iberis* *sempervirens*
6.	Convexleaf Japanese Holly	*Ilex* *crenata* 'Convexa'
7.	Drooping Leucothoe	*Leucothoe* *catesbaei*
8.	Box Honeysuckle	*Lonicera* *nitida*
9.	Oregonhollygrape	*Mahonia* *aquifolium*
10.	Carolina Rhododendron	*Rhododendron* *carolinianum*
11.	Catawba Rhododendron Hybrids "P.J.M." and "Purple Gem"	*Rhododendron* *catawbiense* hybrids
13.	Hybrid Azalea	*Rhododendron* *hybrid*
14.	Korean Rhododendron	*Rhododendron* *mucronulatum*
15.	Snow Azalea	*Rhododendron* *mucronatum*
16.	Amoena Azalea	*Rhododendron* *obtusa* 'Amoena'
17.	Torch Azalea	*Rhododendron* *amoenum*
18.	Korean Yodogawa Azalea	*Rhododendron* *poukhanense* 'Yedoense'
19.	Reeves Simmia	*Skimmia* *reevesiana*

I. Deciduous and Evergreen Vines

1.	Fiveleaf Akebia	*Akebia quinata*
2.	European Bittersweet	*Celastrus orbiculatus*
3.	Clematis	*Clematis hybrids*
4.	Sweet Autumn Clematis	*Clematis paniculata*
5.	Bigleaf Wintercreeper Euonymus	*Euonymus fortunei* 'Vegatus'
6.	Baltic English Ivy	*Hedera helix* 'Baltica'
7.	Climbing Hydrangea	*Hydrangea petiolaris*
8.	Japanese Wisteria	*Wisteria floribunda*
9.	Chinese Wisteria	*Wisteria sinensis*

J. Deciduous and Evergreen Groundcovers

1.	Creeping Cotoneaster	*Cotoneaster adpressa*
2.	Bearberry Cotoneaster	*Cotoneaster dammeri*
3.	Rockspray Cotoneaster	*Cotoneaster horizontalis*
4.	Baltic English Ivy	*Hedera helix* 'Baltica'
5.	Bar Harbor Juniper	*Juniperus horizontalis* 'Bar Harbor'
6.	Creeping Juniper	*Juniperus horizontalis*
7.	Green Carpet Juniper	*Juniperus chinensis* 'Wiltoni'
8.	Sargent Juniper	*Juniperus chinensis* 'Sargenti'
9.	Japanese Spurge	*Pachysandra terminalis*

K. Garden Flowers, Herbaceous Perennials

1.	Butterfly Weed	*Asclepias tuberosa*
2.	Astilbe	*Astilbe hybrids*
3.	Garden Chrysanthemum	*Chrysanthemum morifolium*
4.	Delphinium	*Delphinium hybrid* (esp. *D. belladonna h.*)

5.	Bleeding Heart	Dicentra spectabilis
6.	Daylily	Hemerocallis hybrids
7.	Evergreen Candytuft	Iberis sempervirens
8.	True Lavender	Lavendula vera (esp. 'Munstead')
9.	Peony	Paeonia hybrids
10.	Oriental Poppy	Papaver orientale

Courtesy of Joliet Junior College Agriculture Department

INFORMATION SHEET

DETERMINATION OF AIR FILLED PORE SPACE FOR CONTAINER GROWN NURSERY STOCK

Restricted soil aeration in soil mixes for container grown plants can 1) be the greatest limiting factor in the development of an extensive root system, 2) can impair the essential process of respiration of an established root system that retards both water and nutrient absorption, 3) prevent the orderly functioning of essential biological processes associated with good soil fertility, and 4) increase the probability of root disease problems.

The water condition in container plant production remains near field capacity under irrigation. The air-filled pore space following drainage to field capacity is an important aspect of soil mixes. It is through air-filled pores that gases are exchanged between soil mixes and the atmosphere. This pore space is influenced by the amount and type of amendments used in the soil mix. Since we cannot yet predict water and air-filled pore conditions for different mixes, individual growers must measure air-filled pore space for their own mix.

A way to determine the air-filled pore space after drainage (at field capacity) is as follows:

1. Slowly immerse the container plant into a larger volume of water until the water begins to appear at the surface of the soil mix in the container. The object of slow wetting is to avoid trapping air in pores. Be careful not to let any water enter from the top of the container.

2. After water has appeared at the surface of the soil mix, quickly remove the container and set it into a bucket or water-tight container and record the weight in ounces or grams. Call this weight, W_1.

3. After weighing the container, remove it from the bucket and allow it to drain for 24 hours away from drafts, direct sun, or high temperature, to avoid excessive evaporation.

4. After 24 hours, reweigh the container in the same bucket. Call this weight W_2.

5. It is necessary to determine the volume occupied by the soil mix in the container. Mark the top of the soil line around the inside of the container. Remove the soil mix, clean out residues, line the container with a very thin polyethylene plastic or saran wrap. Refill the container with water to the soil line mark and weigh. Call this weight W_3. Empty water from the container and reweigh. Call this weight W_4. Remember, keep the units of weight for all measurements in either ounces or grams.

6. Compute the percent air-filled pore space at field capacity by dividing the loss in weight (W_1-W_2) by the volume of the soil mix (W_3-W_4), and multiply the quotient by 100.

Example: a) weight of saturated 2 gallon container of rhododendron and bucket = 5100 grams (W_1)

b) weight of container and bucket after draining 24 hours = 4300 grams (W_2)

c) weight of drained water = 800 grams ($W_1 - W_2$)

d) weight of container plus water up to the soil line = 5250 grams (W_3)

e) weight of container without water = 600 grams (W_4)

f) volume of soil mix = 4650 grams ($W_3 - W_4$)

g) divide weight of drained water (800 grams) by volume of soil mix (4650 grams) - .17
multiply by 100 for percent air-filled pore space of 17%

Values for the best percent air-filled pore space for container growing have not yet been established. However, a good farm soil to produce good corn should be at least 10%. A range of about 15-25% air-filled pore space would be desirable for container grown ornamentals.

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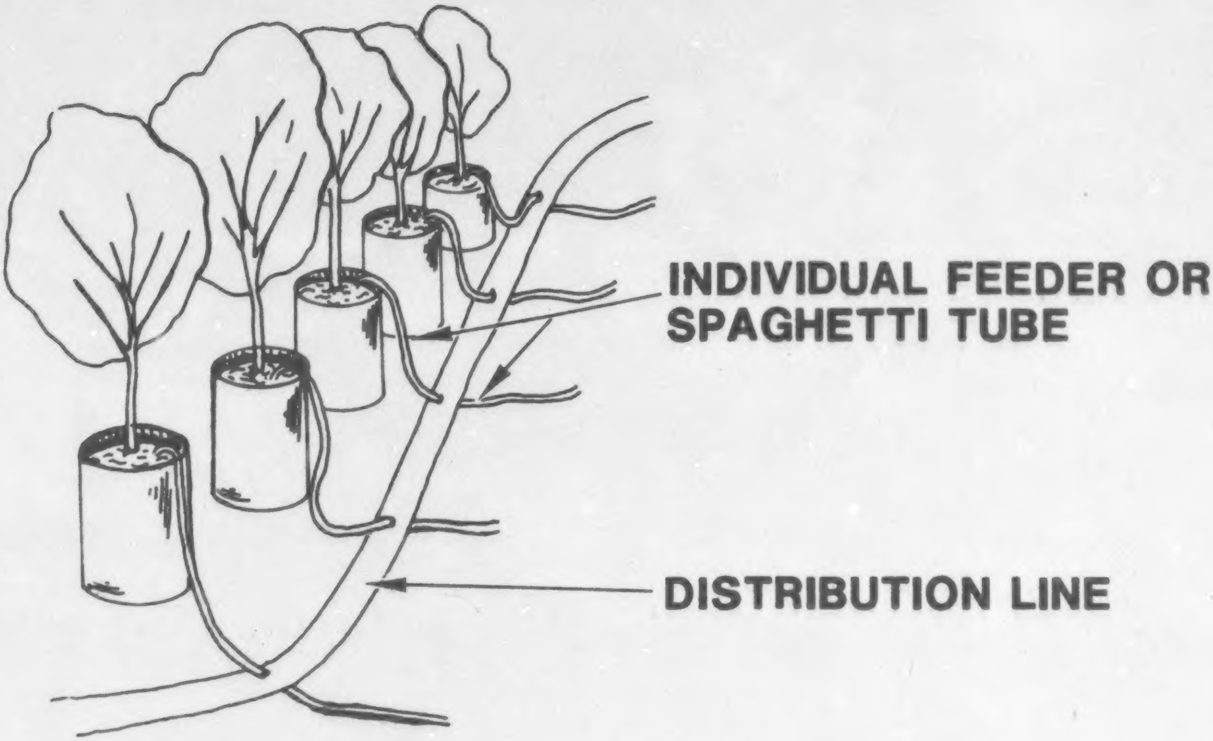
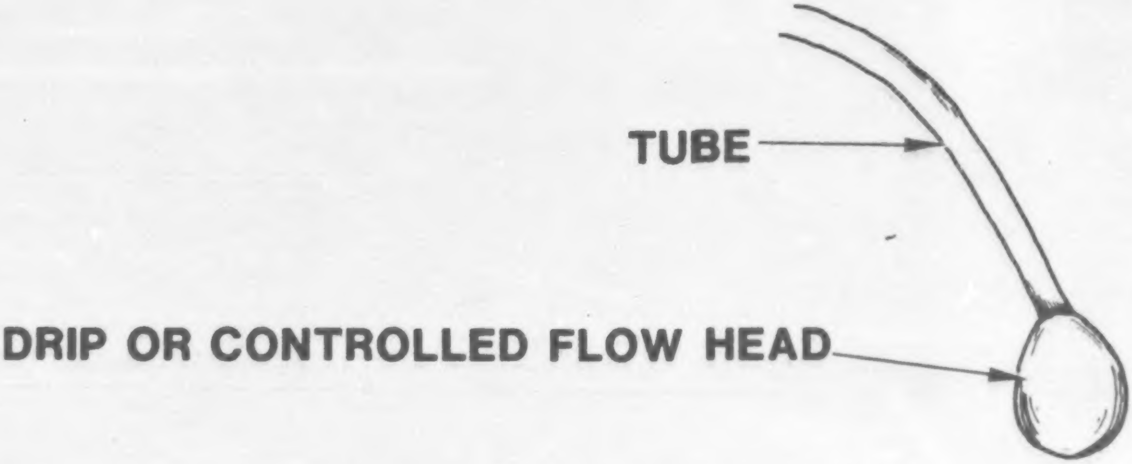
*Prepared by Fred K. Buscher, Area Extension Agent, Horticulture, O.S.U., Wooster, Ohio and David Van Doren, Professor, Department of Agronomy, OARDC, Wooster, Ohio

LAYOUT FOR INDIVIDUAL PLANT WATERING SYSTEM


INDIVIDUAL FEEDER OR SPAGHETTI TUBE
DISTRIBUTION LINE


TUBE
DRIP OR CONTROLLED FLOW HEAD

TUBE HEADS OR NOZZLES

GROWING MEDIA COMPONENTS

FOR DRAINAGE	FOR WATER RETENTION	FOR BODY
Sand	Spagnum peat	Soil
Perlite	Vermiculite	Ash
Bark	Some soils	Sand
Shavings		

EXAMPLES OF GOOD GROWING MEDIA

MIXTURE A

- 1/2 sharp sand
- 1/2 sphagnum peat

MIXTURE B

- 1/2 sharp sand
- 1/4 sphagnum peat
- 1/4 humus

MIXTURE C

- 1/4 ash
- 1/4 coarse sand
- 1/4 sphagnum peat
- 1/4 humus

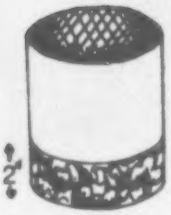
MIXTURE D

- 1/3 sandy loam soil
- 1/3 sphagnum peat
- 1/3 humus

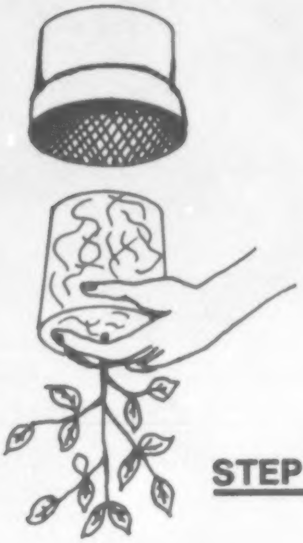
MIXTURE E

- 1/3 pine bark
- 1/3 sphagnum peat
- 1/6 perlite
- 1/6 coarse sand

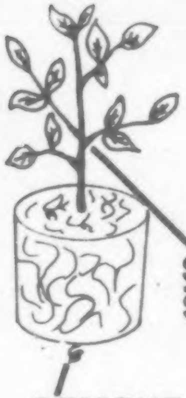
STEPS IN CANNING A ROOTED LINER



STEP 1. ADD CHIPS

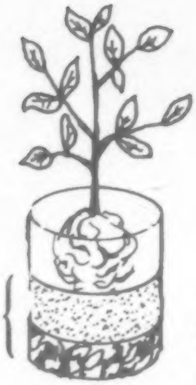


STEP 2. REMOVE PLANT

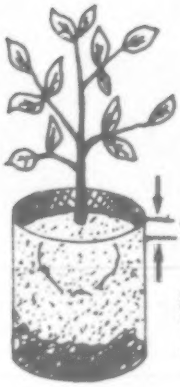


STEP 3. REMOVE SHOULDERS

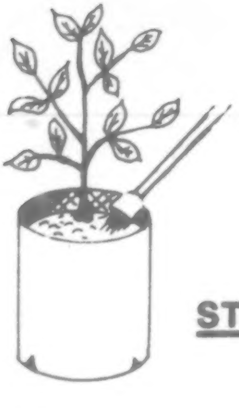
REMOVE SCREW ROOT



STEP 4. FILL CAN 2/3 FULL WITH MEDIA-ADD PLANT



STEP 5. FILL CAN AND FIRM MEDIA



STEP 6. WATER

TRANSPARENCY DISCUSSION GUIDE

I. Transparency - LAYOUT FOR INDIVIDUAL PLANT WATERING SYSTEM

Individual plant watering systems are commonly used in the nursery industry. They are especially valuable when a great number of container plants must be watered. Workers can save many hours of watering time and need only to make sure a spaghetti tube is in each container. Another advantage is hundreds of plants can be watered simultaneously.

How does an individual plant watering system work? Numerous spaghetti tubes or individual feeders are inserted in a distribution line. The free end of the spaghetti tube has a contolled flow or drip head which is placed on the soil in each container. The main valve is turned on manually or automatically allowing water to trickle through the drip head into each container.

II. Transparency - GROWING MEDIA COMPONENTS

A. Point out the function of different materials used in growing media.

B. Discuss why it is important to have both good drainage and water retention.

C. Identify examples of good growing media, and discuss their similarities. Point out the percentage of different components.

III. Transparency - STEPS IN CANNING A ROOTED LINER

A. Explain the steps taken in canning a rooted liner.

B. Discuss the importance of breaking the soil mass and removing the screw root.

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

GROWING CONTAINER NURSERY CROPS

Short Answer

1. List three reasons for using containers to sell plants:

   1. Ease of handling
   2. Standardized growing methods
   3. High degree of transplant survival

2. List three types of containers and one advantage and one disadvantage for using each type:

Type of Container	Advantage	Disadvantage
1. cans	durable	can be difficult to remove plant
2. plastic pots	inexpensive	crack with age
3. styrofoam	light weight	break easily

3. What are four requirements for growing media used in container plants?

   1. Good drainage
   2. Good water holding capacity
   3. Nutrient holding capacity
   4. Heavy enough to support plant

4. List two components of soil mixes that fit in the following categories:

Used for Drainage	Used for Water Retention	Used for Body
1. sand	1. sphagnum peat	1. soil
2. perlite	2. vermiculite	2. ash

5. Explain the process of transplanting liner stock into gallon cans:

   1. Place 2" of wood chips or similar material in base of can.
   2. Remove the screw root and shoulders from the liner--break up the soil ball.
   3. Fill the can 2/3 full with media and add plant
   4. Fill the can and firm the media.
   5. Water.

6. Name three types of watering systems used for container nursery stock:

   1. Method of application
   2. Type of soil mix
   3. Type of plant

8. What are two reasons for pruning and training container nursery stock?

   1. To develop a full plant
   2. To develop an espalier

9. Two ways to control weeds in container nursery stock include:

   1. Hand pulling
   2. Herbicide

10. List three things that must be considered in choosing a location for container nursery stock:

    1. Availability of good water
    2. Easy access to major roads
    3. Macro- and microclimates

UNIT G: GROWING HORTICULTURAL CROPS

PROBLEM AREA: GROWING BULB CROPS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the late fall and early spring.

The estimated instructional time for this problem area is 8 to 14 days, depending on how far the teacher wishes to go in developing bulb forcing skills at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be 3 days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, student worksheet, and test questions were developed by Jim Ethridge, Joliet Junior College, and Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Transparency masters and the transparency discussion guide were prepared by the Vocational Agriculture Service, University of Illinois. The information sheets "Ball Seed Easter Lily Forcing Guide - Easter: April 11, 1982" and "Ball Seed Easter Lily Culture Tips" were produced by the Ball Seed Company, West Chicago, IL. The information sheet "The Timing of Easter Lilies By Leaf Counting" was written by Dennis P. Stimart, University of Maryland was published in the November, 1979 issue of "The Maryland Florist." Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Field Test Teachers.

TEACHER'S GUIDE

I. Unit: Growing horticultural crops

II. Problem area: Growing bulb crops

III. Objectives: At the close of this problem area, the student will be able to:

1. Identify 8 "bulbs" commonly forced in the greenhouse or home.
2. Grow Easter lilies, tulips, daffodils or begonias.
3. Identify terminology used in the forcing of "bulbs".

IV. Suggested interest approaches:

1. Present the question, "What is "bulb" forcing, and how are bulbs forced?
2. Have the students list all the bulb crops they have seen in the local stores.
3. Ask the students if their parents buy Easter lilies in the spring. Then, ask the students if they would like to grow Easter lilies for their parents.
4. Bring a lily bulb, a tulip bulb, a crocus corm, and a tuberous begonia tuber to class and ask the students if they can identify them. Then, ask them to describe the characteristics of each.

V. Anticipated problems and concerns of students:

1. Why force "bulbs" out of season?
2. What is forcing?
3. Why can't all "bulbs" be forced using the same method?
4. Why can't some "bulbs" be forced successfully?
5. What is a basal plate on a bulb?
6. How do bulbs and corms differ?
7. How do tulip bulbs and lily bulbs differ?
8. What is a blasted bulb?
9. What is blindness in bulbs?
10. What is a bulb pan?

11. How do bulb pans and other pots differ?

12. What is fasciation?

13. Why do stems drop over in tulips and daffodills?

14. What are NP "bulbs"?

15. What are PC "bulbs"?

16. How do I identify plants by their "bulbs"?

17. How does one harden a forced bulb crop?

18. Why do people remove pollen from forced bulb flowers?

19. What is rogueing?

20. How does the term "goose neck" refer to daffodils?

21. What different forcing periods exist for the different forced bulbs?

22. What "bulbs" cannot be forced successfully?

VI. Suggested learning activities and experiences:

1. Have a local "bulb" forcer visit your class and have him or her identify the common forcing techniques they use. Emphasis should be on the most common techniques used.

2. Have a local "bulb" forcer donate damaged, diseased, or over-mature plant materials that have been forced and discuss those problems.

3. Divide the class into groups of 3-4 students. Provide a list of materials to be forced and have each group identify first and second choices of "bulbs" to force. Assign to students the responsibility of forcing that crop (or a portion of the crop if more than one group of students is involved).

4. Discuss the terminology used when forcing "bulbs".

5. Have the students complete the worksheets provided in this problem area, using the recommended references.

6. Have the students identify 10 "bulbs" that are commonly forced.

7. Take a field trip to a local conservatory when holiday (Easter) crops are on display.

8. Have the students maintain a S.O.E. Record Book on the crop they have forced.

9. Have the students visit a garden center or retail florist and determine what minor "bulbs" they sell for forcing.

10. Grow a red tulip crop for Valentine's Day.

11. Grow an Easter lily crop. Use the Job Sheet "Easter Lily Forcing Records" and the laboratory exercise "Forcing Bulbous Plants, Easter Lilies."

12. Grow a daffodil and minor bulb crop for the time between Valentine's Day and Easter.

13. Grow a cut flower crop of daffodils or iris to be used in a floral design demonstration.

VII. Application procedures:

1. Once the students have successfully grown a crop from bulbs, it should be possible for them to grow another of the same crop with greater success.

2. Once success has been achieved with a crop, it should be possible for the class and each individual to grow other crops using similar techniques. Crops such as fuschia, iris, gladiolus, and crocus should be successfully produced.

3. The skills learned in the problem area should enable the student to be a better consumer in the selection of plant material for others, as a retail sales clerk.

4. Information in the problem area, as it relates to the keeping of records, will assist the student in making a decision about career choices in the production greenhouse area.

VIII. Evaluation:

1. Prepare and administer an objective paper and pencil test covering the material you presented and discussed in this problem area.

2. Evaluate worksheets completed by the students, as well as their record books.

3. Conduct a practical performance test using the crops grown by the students.

IX. Reference and aids:

1. Holland Bulb Forcers' Guide, Netherlands Flower-Bulb Institute, 5 World Trade Center, Suite 6217, New York, NY 10048.

2. Information Sheets included in this problem area:

   a. "Ball Seed Easter Lily Forcing Guide - Easter: April 11, 1982"
   b. "Ball Seed Easter Lily Culture Tips"
   c. "The Timing of Easter Lilies by Leaf Counting"
   d. "Growing Lilies for Easter the Controlled Temperature Method"
   e. "Growing Lilies for Easter the Commercial Precooling Way"
   f. "Growing Lilies for Easter by doing your own Precooling"
   g. "Growing Lilies for Easter the Cold Frame Method or Natural Cooling Method"

3. University of Illinois, Vocational Agriculture Service subject matter Unit #5014 "Growing Lilies."

4. Student Worksheets included in this problem area:

   a. "Bulbs"
   b. "Bulb forcing terminology"

5. Transparencies:

   a. Included in this problem area.
   b. In Metropolitan Core I, Unit F, Problem Area 3.

6. Growing Container Plants, A Guide to Production in the High School Greenhouse, Vocational Education Productions, California Polytechnic State University, San Luis Obispo, CA 93407.

7. 1982 Cornell Recommendations for Commercial Floricultural Crops, Part I and II, New York State College of Agriculture and Life Sciences, Cornell University.

INFORMATION SHEET

BALL SEED EASTER LILY FORCING GUIDE - EASTER: APRIL 11, 1982 FOR COMMERCIALLY PRECOOLED BULBS

NOTE: Before potting, dip bulbs for one-half hour in a solution of Kelthane 35% wettable powder using 1 1/3 lbs. in 100 gallons of water. Do not use emulsifiable concentrate form. This will cause damage.

Date	Days before Easter	Approximate stage of plant development
Up to December 12		Since bulbs could be received prior to start date on the forcing schedule, pot immediately and place potted bulbs in a 50-55°F storage for as short a duration as possible. Prolonged storage could result in overcooling.
December 12	120	Water thoroughly. Apply either Lesan-Terraclor or Lesan-Benlate. (See other side). Maintain a 60-62°F soil temperature in the pots.
December 27	105	Roots are forming.
January 7	94	Shoots begin breaking through soil. Repeat Lesan application. If shoots are slow to emerge, long-day treatment at this time will accelerate the bulbs and produce a uniformly timed crop. Light from 10:00 p.m. till 2:00 or 3:00 a.m. Use mum lights (20-25 foot candles). Light for about 1 week. Give slower emerging bulb 3 or 4 additional nights of light.
January 17	84	Plants should be 2-4 inches tall. Sort plants and raise temperature gradually on those not through soil or only one inch tall.
January 29	72	Flower buds should be forming. Sort out most advanced plants and place in cooler area.

Date	Days before Easter	Approximate stage of plant development
February 3	67	Plants should be 3-5 inches tall. Spray for aphids as needed. Leaf-counting method should be initiated at about this time.
February 12	58	Plants should be 6-7 inches tall. Repeat Lesan application. Time to consider the use of a growth regulator such as A-Rest.
February 28	42	Buds should be visible in the growing tip. At 63°F night and 68°F day air temperatures, plants should be marketable in 5 weeks.
March 7	35	Plants should be approximately 8-10 inches tall. Check for aphids.
March 14	28	Buds 1-1½ inches long. Begin to space plants.
March 21	21	Buds should be beginning to turn down. Buds should be 2-3 inches in length. A bud which has swollen and become creamy white is 4 to 7 days from opening at a 55-60°F temperature.
April 4	7	Plants ready for market.
April 11	0	Easter

THIS GUIDE IS A COMPOSITE OF SEVERAL SCHEDULES.
THESE DATES ARE ONLY APPROXIMATE.

INFORMATION SHEET

BALL SEED EASTER LILY CULTURE TIPS*

SOIL

Must be coarse, well-drained. 2 parts loam, 2 parts peat moss, 1 part sand or rice hulls. To reduce the possibility of scorch occurring, maintain a pH of 6.5-7 and avoid high phosphorus levels.

Sterilize soil mix before potting. Have soil tested to determine pH and fertilizer requirements. If the pH is too low, add dolomitic limestone to the potting mix in the same amount as prescribed by the soil test.

FERTILIZER

A general recommendation would be to use a 16-4-12 or 15-0-15 fertilizer at 100-200 ppm each watering. Slow-release fertilizer may be incorporated into the soil after steaming. Use osmocote just prior to potting. For soils low in fertility and not to be fertilized by injection, use 13 lbs. of Osmocote; mix throughly. If soil is to be fertilizer injected, use one-half the above rates of slow release fertilizers. Use soil test as a guide. Begin fertilizing when plants are ½ to 1 inch high and continue until buds turn down or approximately two weeks before Easter.

POTTING

POT BULBS UPON RECEIPT AFTER DIPPING IN A SOLUTION OF KELTHANE. Place them deep in the pot to allow for development of stem roots. Center the bulbs in the pot, making sure that the peak of the bulb is centered. Fill the pot with soil mix and firm. Water thoroughly. Drench with Lesan 35% WP (8 oz.) plus Terraclor 75% WP or Benlate 50% WP (8 oz.) in 100 gallons of water. Establish a program of Lesan drenching every 3-4 weeks. If bulbs are received prior to starting date on forcing schedule, place potted bulbs in 50-55°F house. Bulbs received with sprouts should be handled in the same manner, but care should be taken not to injure shoots.

REGULATION OF PLANT GROWTH

Beginning with the 120th day before Easter, maintain a 60-62°F soil temperature in the pots. In late January, switch to forcing by air temperature. An average of 70°F should do the job (60° nights/80° days). Adjust uniformity of development by moving slower plants to a warmer location and vice-versa. Adjust crop timing according to forcing schedule by raising or lowering temperature (2°). For increase in plant height, use mum lights from 10:00 p.m. - 2:00 a.m. from February through March. For shorter plants, height may be controlled by growth retardants, such as Phosfon or A-rest. Pulling black cloth at 5:00 p.m. and removing at 8:00 a.m. from shoot emergence till near flowering will reduce height also.

* Ball Seed Company, West Chicago, Illinois 60185 312/231-3500.

INSECT CONTROL

Aphids-Syston, Vapona, Thiodan
Fungus Gnats - Diazinon (not registered for this use), Temik.

CAUTION: READ LABEL AND FOLLOW DIRECTIONS!

GENERAL

Uniformity in all aspects of culture cannot be over-emphasized. Pot at the same depth; use the same amount of soil per pot; firm at the same pressure; water uniformly; insure uniform temperature throughout the forcing area.

CONTROLLED-TEMPERATURE FORCING (CTF)

CTF is a method of timing noncooled bulbs only for Easter by precise manipulation of temperature. Method: Noncooled bulbs are potted on arrival and held at 63-65°F (soil temerature) for about 3 weeks, then dropped to 35-40°F for Nellie White, for six weeks. Soil temperature is then raised to 62°F. See forcing schedule on opposite side, beginning on Feburary 3. For added insurance for proper timing, you can use supplemental lighting at 20-25 foot-candles, 10:00 p.m. to 3:00 a.m., beginning with shoot emergence and continuing for 7 days.

LEAF-COUNTING METHOD (LCM)

LCM is a method of exacting the established methods of forcing lilies for Easter, whereby actual leaf count is used as a basis for determining state of development. The basis for this method is that lilies initiate all leaves by the time the plant is 4-6 inches high. Write for further information if needed.

METHOD:

1. About the 1st week in February, when plants are 4-6 inches high, determine the total number of leaves on the crop by selecting 2 or 3 plants from each section of lot and counting (a) the number of leaves which have unfolded off the leaf spindle or stalk and (b) the number of leaves which remain on the spindle.

2. Calculate the leaf-unfolding rate by dividing the number of leaves remaining on the stalk unfolded by the number of days till the first Sunday in Lent (February 28). This will give you the number of leaves that must unfold per day.

3. Select several representative plants and mark the last few leaves that have unfolded from the stalk. A paper punch or something similar can be used for this.

4. One week later, determine the actual number of leaves unfolded. Subtract the number of those unfolded in the past week for those yet to unfold and recalculate the required unfolding rate (step 2). Make the necessary temperature adjustments and then repeat steps 2 and 3.

INFORMATION SHEET

THE TIMING OF EASTER LILIES BY LEAF COUNTING*

Flower initiation in the Easter lily, Lilium longiflorum, does not occur until the previously cooled bulbs have been placed in the greenhouse and shoots have emerged to a height of 4 to 6 inches. Assuming that you are following one of the programming phases of either the natural-cooling method, controlled temperature forcing (CTF), the home case-cooled method or the commercial case-cooled system, flower initiation takes place between Jan. 20-29. At this time the apical meristem changes from making leaves to forming floral parts.

The number of leaves present at the time of floral initiation can vary each season. Environmental factors perceived by the Easter lily in the bulb production field, as well as cultivar differences, affect this number. Therefore, the number of leaves to be unfolded to obtain visible bud (30 days before Palm Sunday) in 1981 probably differed from the number present in 1980 and will differ from the number in 1982.

Easter falls on different dates each year. For example, the Easter of 1978 was on March 26, Easter of 1979 occurred on April 15, and Easter's of 1980 and 1981 occurred on April 6 and April 19 respectively. This means the length of the greenhouse phase of forcing Easter lilies varies each season. Consequently, with either an early or a late Easter there can be either a small or large number of leaves that must be unfolded within a defined time period.

There are four dates of importance in the production of Easter lilies: (a) programmed bulbs should be placed into the forcing phase in late December; (b) 30 days before Palm Sunday the first visible buds must be present; (c) on Palm Sunday the first open flower on each plant should appear; and (d) by Easter Sunday there should be few if any remaining Easter lilies in your greenhouse. To meet this final date, it is important for you to know how many leaves are present after floral initiation and the rate at which they must be unfolded.

The leaf counting technique and time schedule method of forcing Easter lilies was developed by Dr. H. F. Wilkins in the Department of Horticulture at the University of Minnesota. This concept accounts for both the different number of days in the greenhouse phase and leaf number experienced each season.

In summary, the total number of leaves to be unfolded by the visible bud date in the greenhouse phase is determined after floral initiation, the number of days to visible bud is calculated, and finally, the weekly unfolding rate of leaves to meet this goal is determined. The procedure is as follows:

1. Record the average date of shoot emergence.
2. When the plants are 4-6 inches tall (Jan. 29), flower buds should be present. At this time, cut off 10 random shoots at soil level for every 2,000 bulbs from each clone and bulb source.

3. Take these shoots to a well-lighted area, count, record, and average the total number of leaves per sample lot. A large needle and magnifying lens (reading glass) will help you remove small, scale-like leaves near the growing point. The embryo-like flower buds should be present.

4. Randomly select and mark 10 average plants in the greenhouse that will correspond to individual sample lots whose total leaf counts were just determined. Count and average the number of leaves that have unfolded to a 45-degree angle on these plants. A bamboo stake with a paper label wired to it will help in marking these plants and in recording weekly individual leaf data.

5. On a routine, weekly basis count and record the number of leaves unfolded to a 45-degree angle from the stem. The last individual leaf counted can be marked weekly with a paper-punch hole to avoid repetitious counting. Then, only unfolded leaves above the most recently marked leaf need be counted each week.

6. Subtract the average number of leaves that have unfolded from the predicted average leaf total. This will tell you how many leaves are yet to be unfolded.

7. Divide the number of leaves already unfolded by the number of days from emergence until the present date. This will tell you how many leaves have been unfolding each day.

8. Determine the visible bud date. This is 30 to 35 days before Palm Sunday. It takes at least 30 days to develop an open flower from the time first buds are seen.

9. Divide the number of leaves left unfolded by the number of days left from the date of counting to 30 days before Palm Sunday (visible bud date). This figure tells how many leaves you must unfold each day to make the estimated visible bud date.

10. Each week count, record, and determine the average number of leaves unfolded daily the previous week. Compare the data and determine if the leaf number was greater or smaller than the number required to keep the crop on time.

11. If the crop is developing off-schedule, the greenhouse temperatures should be increased or decreased appropriately to attain the desired rate of leaf unfolding.

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[*] The above article by Mr. Stimart is from "The Maryland Florist," Nov. 1979.

INFORMATION SHEET

GROWING LILIES FOR EASTER THE CONTROLLED TEMPERATURE METHOD

BULB : Nonprecooled bulbs shipped direct from field or nearest shipping point.

ARRIVAL DATE : October

POTTING DATE : Pot on arrival.

SOIL : Use a porous lime rich soil (pH 7). Use 5lbs. of 18-9-9 Osmocote per cubic yard of soil. Some growers prefer to place one-half inch layer of gravel in bottom of pot. With first watering, an application of Dexon and Terraclor is recommended; 8 ounces of 35% WP Dexon, and 4 ounces of 75% WP Terraclor per 100 gallons. Repeat the Dexon application every four weeks.

STORAGE TEMPERATURE: Keep pots at 63°F for two to three weeks, then drop temperature to 40°F. Maintain 40°F. Temperature for six weeks. It is important that they get this six weeks of 40°F. precooling.

FORCING PROCEDURE : After the precooling, bring into the greenhouse and force at 58-60° F. for three weeks then 60-65° F.

FEEDING : Start liquid feeding at 2 to 3 week intervals with two lbs. of 25-0-25 per 100 gallons of water. Some growers use alternate feedings with calcium nitrate 1½ lbs. per 100 gallons.

WATERING : Water is critical for early uniform emergence. Do not allow soil to dry out after sprouting. Height control can be effected by relying on syringing to some extent rather than heavy watering after buds are set.

TEMPERATURE : 60-65° F. should bring these in at Easter. Be sure that temperature is recorded at pot level.

INFORMATION SHEET

GROWING LILIES FOR EASTER THE COMMERCIAL PRECOOLING WAY

BULB : Precooled bulbs.

ARRIVAL DATE : Late November-early December.

POTTING DATE : On arrival.

SOIL : Use a porous lime rich soil (pH 7). Use 5 lbs. of 18-9-9 Osmocote per cubic yard of soil. Some growers prefer to place one-half inch layer of gravel in bottom of pot. With first watering, an application of Dexon and Terraclor is recommended; 8 ounces of 35% WP Dexon, and 4 ounces of 75% WP Terraclor per 100 gallons. Repeat the Dexon application every four weeks.

FORCING PROCEDURE : After potting bring into the greenhouse and force at 58-60° F. for three weeks then raise temperature to 60-65° F.

FEEDING : Start liquid feeding at 2 to 3 week intervals with two lbs. of 25-0-25 per 100 gallons of water. Some growers use alternate feedings with calcium nitrate 1½ lbs. per 100 gallons.

WATERING : Water is critical for early uniform emergence. Do not allow soil to dry out after sprouting. Height control can be effected by relying on syringing to some extent rather than heavy watering after buds are set.

TEMPERATURE : 60-65° F. should bring these in at Easter. Be sure that temperature is recorded at pot level.

INFORMATION SHEET

GROWING LILIES FOR EASTER BY DOING YOUR OWN PRECOOLING

BULB :	Nonprecooled bulbs shipped direct from field or nearest shipping point.
ARRIVAL DATE :	October.
COLD STORAGE DATE :	Place bulbs (in case) in cooler immediately upon arrival. Precool bulbs at 40° F. for a period of six weeks.
POTTING DATE :	After six weeks of precooling--which should be late November to early December.
SOIL :	Use a porous lime rich soil (pH 7). Use 5 lbs of 18-9-9 Osmocote per cu. yard of soil. Some growers prefer to place one-half layer of gravel in bottom of pot. With first watering, an application of Dexon and Terraclor is recommended; 8 ounces of 35% WP Dexon, and 4 ounces of 75% WP Terraclor per 100 gallons. Repeat the Dexon application every four weeks.
FORCING PROCEDURE :	After precooled bulbs are potted, bring into greenhouse and force at 58°-60° F. for three weeks, then 60-65° F.
FEEDING :	Start liquid feeding with initial watering and at 2 to 3 weeks intervals with two lbs. of 25-0-25 per 100 gallons of water. Some growers use alternate feedings with calcium nitrate 1½ per 100 gallons.
WATERING :	Water is critical for early uniform emergence. Do not allow soil to dry out after sprouting. Height control can be effected by relying on syringing to some extent rather than heavy watering after buds are set.
TEMPERATURE :	60-65° F. should bring these in at Easter. Be sure that temperature is recorded at pot level.

INFORMATION SHEET

GROWING LILIES FOR EASTER THE COLD FRAME METHOD OR NATURAL COOLING METHOD

BULB	:	Nonprecooled bulbs shipped direct from field or nearest shipping point.
ARRIVAL DATE	:	October.
POTTING DATE	:	Pot on arrival.
SOIL	:	Use a porous lime rich soil (pH 7). Use 5 lbs of 18-9-9 Osmocote per cubic yard of soil. Some growers prefer to place one-half inch layer of gravel in bottom of pot. With first watering, an application of Dexon and Terraclor is recommended; 8 ounces of 35% WP Dexon, and 4 ounces of 75% WP Terraclor per 100 gallons. Repeat the Dexon application every four weeks.
FRAME TEMPERATURE	:	Pots will require 1000 hours (6 weeks) of 40° F. temperature or lower. During warm fall weather conditions this may require as much as ten weeks of fluctuating weather to obtain 1000 hours of accumulated cold. Temperature should not go below 35° F. Exact records must be kept to ensure the length of the cold treatment (1000) hours and bulbs should not be brought into greenhouse until the 1000 hours have been completed.
FORCING PROCEDURE	:	After 1000 hours of cold have been completed, bring into greenhouse; there, keep temperature at 52-54° F for the first two weeks as a guarantee that they have enough cooling-Then increase the temperature to 60-65° F.
FEEDING	:	Start liquid feeding at 2 to 3 week intervals with two lbs. of 25-0-25 per 100 gallons of water. Some growers use alternate feedings with calcium nitrate 1½ lbs. per 100 gallons.
WATERING	:	Water is critical for early uniform emergence. Do not allow soil to dry out after sprouting. Height control can be effected by relying on syringing to some extent rather than heavy watering after buds are set.
TEMPERATURE	:	60-65° F. should bring these in for Easter. Be sure that temperature is recorded at pot level.

WORKSHEET

FORCING POT TULIPS

I. Introduction: Most tulip bulbs forced in the United States are grown as potted plants. The flowering season for potted tulips extends from early January to early May. Refer to the Holland Bulb Forcers' Guide in completing this table:

Flowering Period	Start of Precooling	Time of Planting	Rooting Room	Dates to Greenhouse	Approximate Flowering Date	Weeks of Cold	Forcing Temperature
PT-1							
PT-2 pc					Jan. 5		
PT-3 np					Feb. 7		
PT-4 np					Feb. 22		
PT-5					Feb. 28		
PT-6		Nov. 15				18	
PT-7		Nov. 15				22½	

WORKSHEET

"BULBS"

1. Give an example of a bulb, a tuber, and a corm.

2. How does a corm differ from a true bulb?

3. What is a tuber?

4. There are five important stages in the production of spring-flowering bulbs. They are:

    1.
    2.
    3.
    4.
    5.

5. What is the most important factor to consider when growing bulb crops?

6. Name the three steps to take after receiving a shipment of bulbs. Explain the importance of each step.

    1.

    2.

    3.

7. List six requirements of media used for growing bulbs.

    1.
    2.
    3.
    4.
    5.
    6.

8. What takes place in the rooting room?

9. Name 8 "bulbs" grown in the greenhouse or home.

   1.
   2.
   3.
   4.
   5.
   6.
   7.
   8.

WORKSHEET

BULB FORCING TERMINOLOGY

Define or describe the following:

Basal Plate:

Blasting:

Blindness:

Hardening:

NP:

PC:

Rogueing

Root Plate:

Bulb Pan:

Fasciation:

Forcing:

Spitting:

Stem Topple:

JOB SHEET

EASTER LILY FORCING RECORDS

Instructions: Use the following form to organize the records essential for the production of a successful Easter Lily crop.

Arrival date: ______________________________

Source of bulbs: ______________________________

Bulb variety: ______________________________

Number of cases and bulb size: ______________________________

Condition of bulbs upon arrival:

	Excellent	Good	Fair	Poor
Condition of roots:	_____	_____	_____	_____
Condition of basal plate:	_____	_____	_____	_____
Condition of scales:	_____	_____	_____	_____

Condition of peat: Moist _____ Dry _____

Sprouting No _____ If yes, specify the amounts ______________

Programming method used:

Case-cooled by commercial firm _________

Case-cooled in own facility _________

Potted and cooled in the field or cold frame _________

Potted and Control Temperature Forced (CTF: Rooted for two or three weeks at 62 to 65 degrees Fahrenheit, then cooled for six weeks at 35 to 40 degrees F for 'Ace' or 40 to 45 degrees F for 'Nellie White')

Soil mix: ______________________________

Additives to medium: ______________(do not use superphosphate).

Results of soil test on file: (test before potting)______________

Date bulbs planted ______________________________

Did you soak bulbs 30 minutes in Kelthane (1 1/3 lbs, 35% WP/100 gal) for control of possible bulb mite problems? Yes_____ No_____

Medium population emerged on ____________

Late population emerged on ____________

Placed the rapid, medium and slow, populations into the respective temperature micro-climates in your greenhouse. Yes_______ No______

Did you light your lilies upon emergence for one or two weeks? Incandlescent mum lighting (30 to 35 footcandles) should be turned on from 10 pm to 1 am or (second best) from 4 am to 8 am. This lighting substitutes for inadequate cooling and evens up the crop. This policy should be used for all early Easter dates. Early emerging populations may be lighted for zero to one week, medium-emerging populations for one or two weeks and late-emerging populations for two or three weeks-depending on late or early Easter date, rate of emergence and uniformity.

Do not let temperature rise above 70 degrees during the light treatment. Lighting is not effective at high temperatures and plant height increases will result from 70 degrees forcing during this stage of development.

Dates of soluble salts or soil test: __________, __________, __________, __________, (Test every two or three weeks. File the results.)

Dates of Fungicide Soil Drenches:

Case cooled	CTF	Fungicide	Rates of Application
Potting ______	Potting ______		
Jan. 15 ______	Ist day in greenhouse ______		
Feb. 15 ______	Jan. 25 ______		
Mar. 15 ______	Feb. 28 ______		
(Check roots weekly, drench if necessary before shipping)	Mar. 25 ______		

LEAF COUNT

During the last week of January, dissect 10 representative plants, count the lily leaves and observe if reproductive buds are present. Over the past 12 years, plants from CTF 'Ace' bulbs averaged 91 leaves: 'Nellie White' averaged 81.5 leaves. In 1972 there was a record high of 105 leaves for 'Ace' and in 1978 there was a low of 75 leaves for 'Nellie White' from CTF bulbs.

Adjust temperatures weekly to hasten or slow leaf unfolding.

Date	Average number	Leaves unfolded during past week	Temperature previous week

Average leaf number at flower: ____________________

Date of first bud: ____________________

Height six weeks before market: ____________________

Date buds turn to a right angle with the stem: ____________________

Date of cool storage for flowering delay: ____________________

Length of time for buds to open after white, puffy stage: ____________________

Average flower number: ____________________

Average date of flower: ____________________

Insect control: ____________________

Record soil temperatures daily from planting to the end of January when flower buds have formed. Soil temperature should be 62 to 65 degrees F. for optimal root formation prior to the cold treatment and after the cold treatment until January 25 to 31. Record air temperatures daily from emergence to January 31, when flower buds have formed. Air temperatures should never go above 70 degrees F.

Was soil moist (not dry or saturated) during the cold treatment?
Yes_____ No_____

-NOTES-

- Move potted bulbs into the greenhouse during the last week December, depending on when the bulb cold treatment or requirement is completed. When completed, start forcing immediately. Keep records of all soil temperatures.

- Soil temperature in the greenhouse should not go below 60 degrees F (15 degrees C) and soil temperatures should not go above 65 degrees F (18 degrees C) until January 18-24. Lower soil temperatures may limit root development and cause low flower counts. High temperatures at this stage may delay flowers. Forcing at any air temperature above 70 degrees F (21 degrees C) should not commence until after February 1 to 7. Flower buds do not develop until plants are 4 to 6 inches (10 to 15 cm) tall. Until this time, temperatures near 70 degrees F (21 degrees C) and above may delay flowering.

- One week of lighting is still recommended for late Easters. One week will be enough to insure complete floral induction and uniformity. If bulbs lack adequate cooling because of unusal weather conditions, young plants, upon emergence, should be given two or three weeks of long days at 15 footcandles from 10 pm to 3 am (five hours). Long days (interrupted nights) can substitute for the cold treatment on a day-for-day basis. Keep temperatures at, or lower than, 65 degrees F when lighting.

- Make initial leaf-counting observations between January 25 and 31 for scheduling temperature forcing and leaf unfolding rates. Constant 65 degrees F (18 degrees C) soil temperatures may be adequate until February 1 to 7. Then 70 degrees F (21 degrees C) days will be adequate.

?

LABORATORY EXERCISE

FORCING BULBOUS PLANTS, EASTER LILIES

NOTE: The recent advances in the bulb industry, especially the Easter lily production phase, have permitted growers to follow some new and time-saving practices. It has been discovered that when Easter is late, near the middle of April or later, bulbs can be potted as soon as they have been harvested. These bulbs are then exposed to normal, but not freezing outside temperatures until the forcing period. When Easter is early, the plants may be started by holding the bulbs in storage until regular planting time, approximately 120 days before Easter. This time will vary for different varieties and should be checked before the planting takes place. It has also been noted that bulbs grown in the Pacific Northwest require a regulated period of vernalization, especially if they are to be forced for an early Easter market.

I. Objectives:

1. To develop an understanding of the process of forcing bulbs.
2. To develop an understanding of the interaction of environmental factors and their effects upon the forcing process.
3. To develop the ability to regulate growth of certain bulbous plants, through the control of various environmental factors, for marketing at specified dates.

II. Materials needed:

1. Bulbs of (Easter) lily of the variety Ace or Nellie White.
2. A supply of 6-inch pots and provisions for free drainage. There are several types of good drain covers available commercially, which work well.
3. A planting medium that will not become packed over the growing period with a beginning pH of from 6.5 to 7.0.
4. A fertilizer such as 14-0-44. Research should be reviewed periodically and changes made accordingly.
5. A fungicide such as 35-35 Dexon-Terraclor.

III. Procedure:

1. Early in the fall, determine if bulbs that have been vernalized (precooled) are to be used or if the bulbs will be subjected to the frame treatment (potted immediately and stored at existing temperatures). The period of vernalization is a period of regulated cold treatment comparable to the colder periods late in the fall or early winter, which bulbs planted out of doors would normally undergo. 1000 hours of cooling (six weeks) is required to complete programming.

2. If precooled lilies (vernalized) are to be used, count back 120 days from Easter. This should be your planting date. Order the bulbs so that they will arrive at the correct planting time.

3. Select two dates that might be sample critical dates for marketing, one before Easter and one after Easter. All plants will be started at the same time, but as Easter approaches some plants will be selected to try to make a marketable product for the other two selected dates as well as for Easter.

4. Place the bulbs individually in 6-inch pots, planting near the bottom of the pot. This practice will give additional strength to the stems later by allowing rooting of the stem above the bulb. Place some kind of drainage material or a drain cover along with some planting medium, in the bottom of the pot before the bulb is planted. At this point about one-half of the leaves are already formed. The balance of the leaves and flower buds are under the grower's control.

5. Begin forcing the bulbs at 60 degrees F night temperature immediately.

6. Apply the fungicide as a soil drench to prevent root rot. This should be done at the time of planting. Follow directions for the product used.

7. Apply fertilizer as soon as the first shoots are visible above the soil. This should be a fertilizer that does not become available too rapidly and is low in, or lacking in, phosphorus. Later the type should be determined according to need as indicated by soil tests. Keep the soil pH near neutral.

8. Watering must be done in such a manner that the soil will become thoroughly moist. At first the soil on top may be dry and the soil down in the pot will be sufficiently moist. As growth progresses, more frequent watering will be required. Do not overwater.

9. Place the lilies so that no prolonged shade will strike the plants. Shade will delay maturity and reduce the number of flower buds that will develop. It will also cause stem elongation. The plants must be rotated 90 degrees, weekly, during growth as they have a tendency to lean toward the south and, therefore, will develop bent stems.

10. In those places where the lilies have reached the proper height, the tallest plants should be placed on the north side of an east-west bench and the shorter plants should be placed on the south side of the same bench. If plants are too short early in the growing period, taller plants may be put on the south side of the bench and the shorter ones on the north side. In the first instance, the placement of plants is to maintain continuous bud and flower formation. At this time, it is especially

important that no shade strike the tops of the plants. In the second instance, by placing the shorter plants to the north of the slightly taller ones, there will be a slight reduction in the light intensity which will cause a moderate increase in stem length. By the same token, plant height can be controlled to a certain extent by regulating the photo period. If light is added, the plants will grow taller. If the plants are shaded from 5:00 p.m. to 8:00 a.m., the rate of growth can be slowed down.

11. With the plants selected to flower one week early, try to speed up the forcing process by using 100 watt bulbs, four feet apart and two feet above the plant tops. Additional light should be provided for four hours per night. If the plants are shorter than desired, the temperature may be increased from 65 degrees to 70 degrees F for one month and then decreased to 58 degrees F. For those plants that are to flower one week late, the temperature should be maintained at 58 degrees to 60 degrees F, until the buds are in a white, puffy stage. Water them well when they reach this point and place them in a dark area where the temperature is from 35 degrees to 40 degrees F. They can remain here for a period of 10 to 14 days. Then they can be delivered to the retailer. One indication of maturity that can be used is when the most advanced buds are bent at right angles to the stem, and three to four inches in length--about two weeks is required for maturity. It requires about two days for a well developed and white "puffy" bud to open if the sunlight is normal.

12. Record all incidents and compare the three methods of handling. Things to be recorded include variety, type of treatment before planting, date planted, date of first buds, height six weeks before market, light control, if any, date buds turn to a right angle with the stem, date of cool storage for flowering delay, and length of time to open after white, puffy stage.

IV. Application:

Since the cost of bulbs represents a considerable investment, the grower should take reasonable precautions to produce a marketable product. There is no value to Easter lilies or any other flowering plants if they fail to bloom at the required date. Careful planning is needed before the bulbs are ordered and then every precaution should be taken during the growing seasons to insure blooming at the proper time. The special problem for the grower will be to maintain a good bud count, good foliage characteristics, and to prevent early flowering, especially in years when Easter is later than the first week of April.

V. Observations:

TEACHER'S KEY TO WORKSHEET

"BULBS"

1. Give an example of a bulb, a tuber, and a corm.

   Tulip, Tuberous Begonia, Crocus

2. How does a corm differ from a true bulb?

   A true bulb is a complete or nearly complete miniature of a plant encased in fleshy modified leaves called scales, which contain starch, sugar and some proteins.

3. What is a tuber?

   A tuber is an underground stem swollen with nutrients. It differs from bulbs and corms in that it has no covering of dry leaves and no basal plate from which the roots grow.

4. There are five important stages in the production of spring-flowering bulbs. They are:

   1. The harvesting and preplanting dry storage of the bulbs.
   2. The planting, rooting, and low temperature treatment.
   3. Flower stalk elongation.
   4. Flowering.
   5. Increase of bulb size.

5. What is the most important factor to consider when growing bulb crops?

   Temperature

6. Name the three steps to take after receiving a shipment of bulbs. Explain the importance of each step.

   1. Ventilation: Give the bulbs fresh air. They have been confined for a long time.

   2. Inspection: Check all the bulbs for damage or disease. Notify the supplier immediately if there are any problems. Also, make an internal check to see if the floral development is satisfactory.

   3. Storage: Place the bulbs in the proper storage temperature.

7. List six requirements of media used for growing bulbs.

   1. It must be well-drained.
   2. It must be sterile.
   3. It should have a pH between 6.0 and 7.0.
   4. The soluble salt level should be low.
   5. At the time of planting the media should be moist.
   6. The temperature of the medium should approximate that of the bulbs.

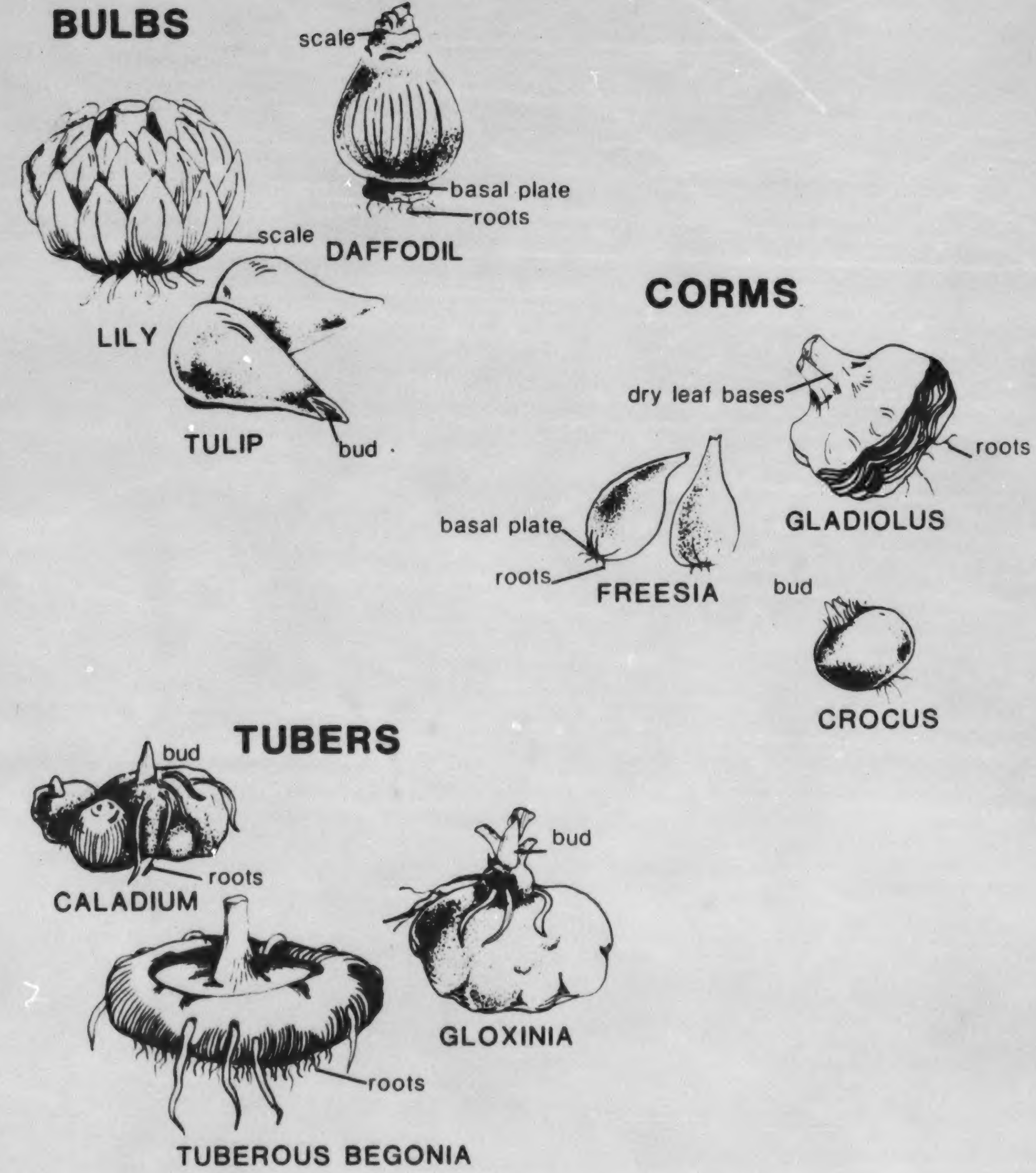
8. What takes place in the rooting room?

The bulbs go through the cooling treatment and roots are formed.

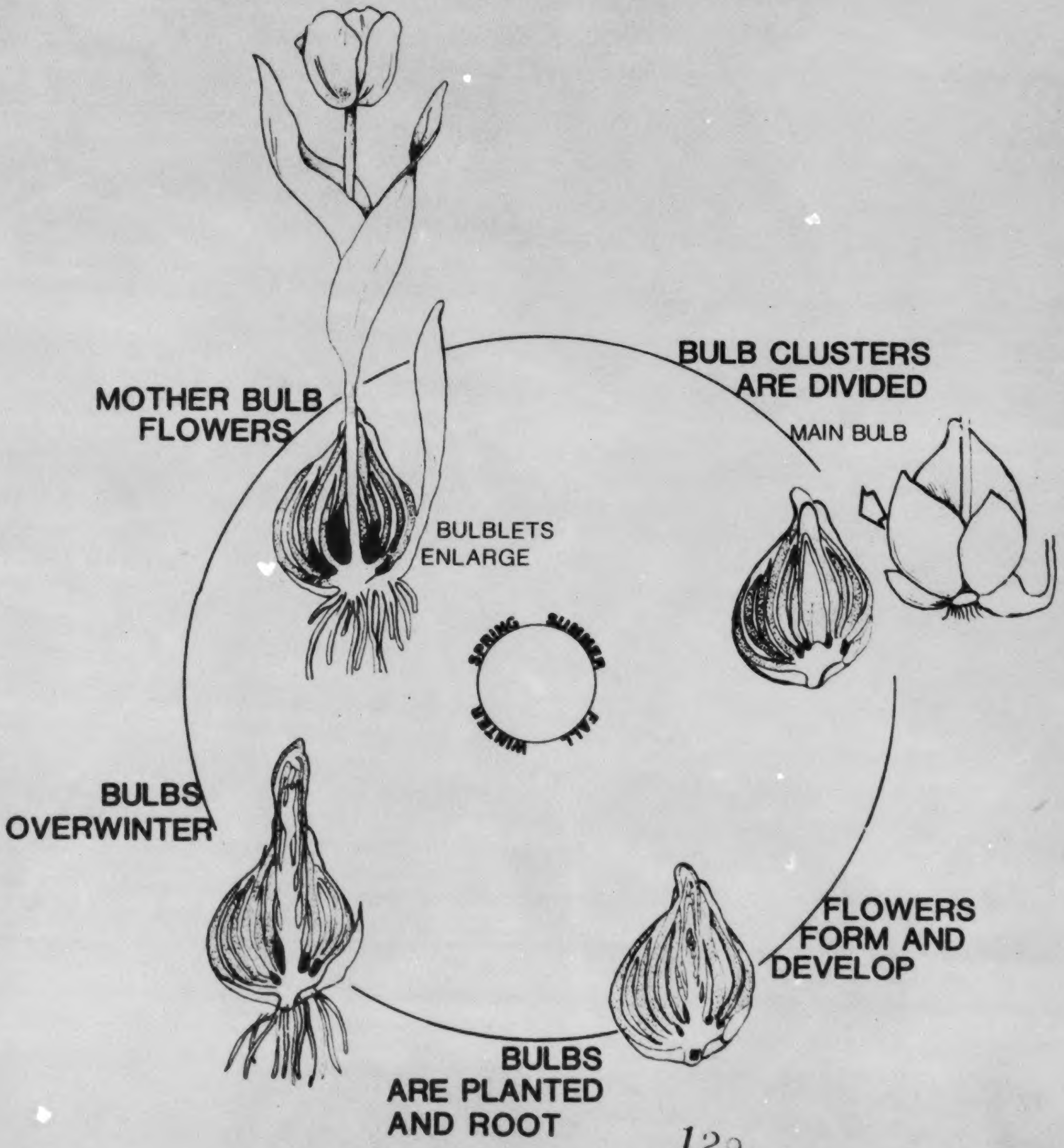
9. Name 8 "bulbs" grown in the greenhouse or home.

1. Tuberous Begonia
2. Crocus
3. Hyacinth
4. Iris
5. Lily
6. Narcissus
7. Tulips
8. Grape-Hyacinth

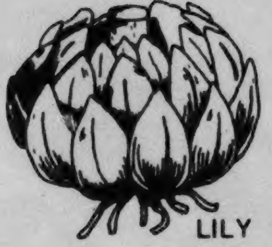
BULBS, CORMS, TUBERS

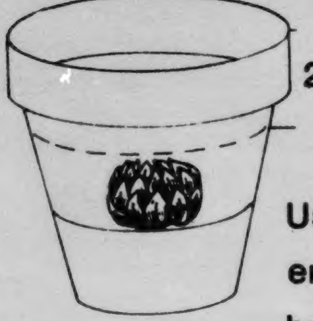

BULBS
scale
scale
basal plate
roots
DAFFODIL
LILY
TULIP
bud
CORMS
dry leaf bases
roots
GLADIOLUS
basal plate
roots
FREESIA
bud
CROCUS
TUBERS
bud
roots
CALADIUM
bud
GLOXINIA
roots
TUBEROUS BEGONIA

BULB GROWTH CYCLE

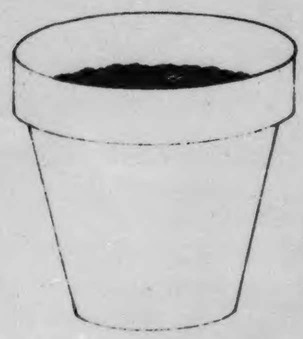

BULB CLUSTERS ARE DIVIDED
MAIN BULB
MOTHER BULB FLOWERS
BULBLETS ENLARGE
SPRING
SUMMER
FALL
WINTER
BULBS OVERWINTER
FLOWERS FORM AND DEVELOP
BULBS ARE PLANTED AND ROOT

POTTING LILIES

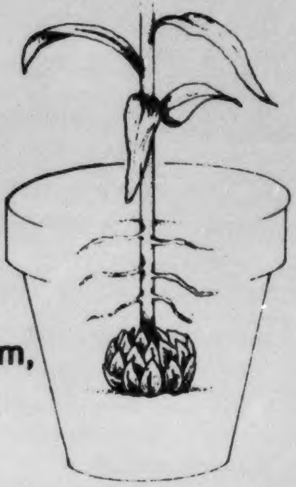




Use a standard pot. Fill with enough soil so the nose of the bulb is about 2" below the rim.

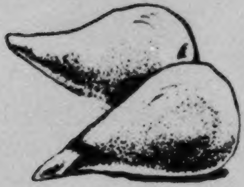


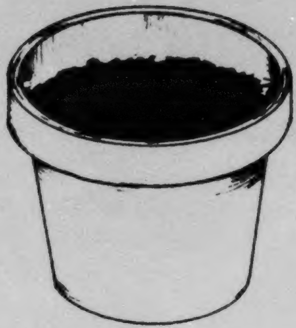
Fill with soil, firm the soil, and water.



Roots develop along the stem, which anchor the plant and absorb nutrients.

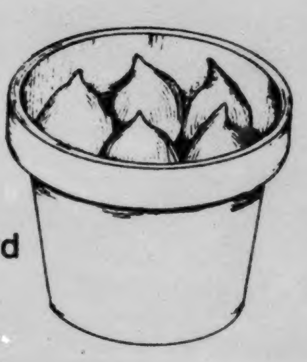
POTTING TULIPS

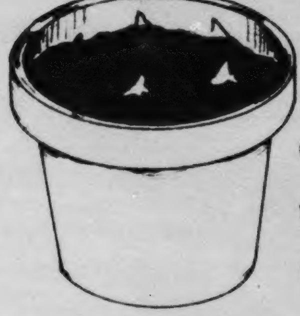

TULIP



Fill container to within 2″ of the top of the pot with planting medium.

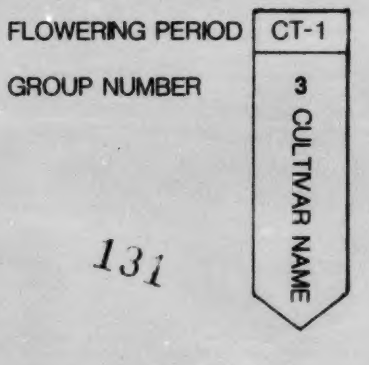
Place bulbs so the nose of each is about even with the top of the container.
The flat side of the tulip bulbs should face outward





Cover the bulbs with planting medium.

SYSTEM OF LABELING
POTS OR FLATS


FLOWERING PERIOD
CT-1
GROUP NUMBER
3
CULTIVAR NAME

TRANSPARENCY DISCUSSION GUIDE

Transparency - BULBS, CORMS, TUBERS

True bulbs are complete or nearly complete miniatures of a plant covered with scales (modified leaves), which store sugar, starch, and protein. Most bulbs have a tunic or a covering of dry papery leaves. A disk of hardened stem tissue called the basal plate holds the scales together. Rooting occurs on the outside edges of the basal plate.

Corms are based on stems swollen with nutrients. Corms lack fleshy scales, but they do have one to two dry leaf bases similar to a tunic. Corms also have a basal plate from which roots grow.

Tubers are underground stems in which food is stored. They differ from corms and tulips in that they have no covering of dry leaves or basal plates. Tubers are usually short, fat and rounded with knobby surfaces with growth buds.

Transparency - BULB GROWTH CYCLE

1. Bulbs are harvested from June to August, graded according to circumference size and stored at warm temperatures to develop floral organs.
2. In the fall, the bulbs are planted and rooting occurs. They are overwintered at low temperatures.
3. After cold requirements have been satisfied the floral stalk elongates and the plant flowers.
4. Bulbs increase in size from the time of flowering to the time of harvesting.

Discussion Questions:

1. Where are our bulbs during each of the four major steps in the growth cycle

2. Why are bulbs grown in Holland or Oregon?

Transparency - POTTING LILIES

1. Fill a standard pot with enough well-drained media so that the nose of the bulb is 2" below the rim.
2. Fill around the bulb to within ½" of the rim. Firm the soil and water.
3. Roots will develop along the stem which provide stability and absorb nutrients.

Transparency - POTTING TULIPS

1. Fill the pot to within 2" of the rim with media.
2. Place the bulbs with their noses up and the flat sides facing the pot wall.
3. Cover the bulbs with media, water and label.

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

GROWING BULB CROPS

1. What are the 5 steps in forcing tulips or daffodils?

   a. harvesting and pre-planting storage
   b. planting, rooting & low temperature mobilization
   c. flower stalk elongation
   d. flowering
   e. bulb production

2. When are bulbs usually harvested?

   June and July

3. What are the 3 steps in the proper handling of tulip bulbs prior to planting?

   a) immediately ventilate upon arrival
   b) inspect the bulbs
   c) proper storage temperature

4. Identify the 3 parts of this pot label for tulips:

   1) Pot tulip Flowering Period 2 - Jan. 20 - Feb. 7.
   2) Group carried into greenhouse for same flowering period.
   3) Name of the cultivar

5. What are 5 advantages of a rooting room over the rooting-bed method?

   a. an extended flowering season
   b. high quality plants can be produced on time and in a reproductible manner
   c. development is under constant supervision
   d. damage due to frost or poor drainage is eliminated
   e. labor can be decreased and the process mechanized

6. To force tulips in the greenhouse 6 factors must be taken into consideration: They are:

a.	temperature	d.	ventilation
b.	watering	e.	sanitation
c.	light	f.	disease & insect control

7. Blasting may be caused by any of the following 3:

   a. heating in transit
   b. ethylene damage
   c. precooling prior to G. stage

8. The final height of a pot daffodil after goose-neck stage, is affected by the following three factors:

   a. overcooling tends to produce tall plants
   b. some cultivars are shorter than others
   c. 60-63° forcing temperatures produce shorter plants than above or below this temperature

9. Identify methods of lily propagation:

   a. Scales
   b. Stem bulblets
   c. Bulbils

10. Mature lily bulbs are generally dug in:

    a. May
    b. July
    c. October
    d. All of these
    e. None of these

11. What is the reason for planting the Easter lily two inches deeper than the nose of the bulb?

    to develop stem roots for the absorption of nutrients and stability

12. The most common insect pest of lilies is the aphid.

13. The most common disease pest of the lily is root rot.

14. Why is anther removed from the lily flower? Anthers may stain the petals if there is any movement of the plant.

15. Lily bulbs can generally be forced in approximately 120 days in the Midwest.

16. As the length of the cold-storage time increases, bud count goes:

    a. up
    b. down
    c. does not change

17. Common night growing temperatures for lilies is: 60°F.

18. The best lily bulb size is:

a. 7-8 inch
b. 8-9 inch
c. 9-10 inch
d. none of these
e. depends on the grower and/or customer

True (T)-False (F)

T 1. Tulips are never dormant.

T 2. Individual cultivars respond differently to the various temperature treatments.

F 3. Precooling of tulips should begin before the bulbs have reached "G" stage.

F 4. The first leaf that develops from the tulip bulb after cooling is from the round side of the bulb.

T 5. When planting tulip bulbs in the pot, place the flat side of the bulb next to the side of the pot.

T 6. Each cultivar of tulip should be checked for "G" stage prior to pre-cooling.

T 7. Tulip bulbs should be stored at 63°F until "G" stage is reached.

T 8. Pre-cooling of tulips for pot plants should be done at 45° to 48°F.

F 9. The primary functions of the tulip planting medium are to anchor the bulbs and serve as a source of nutrients.

T 10. High quality tulips generally are forced into a flower at 10 to 14" tall.

T 11. The flowering season for potted tulips extends from early January to early May.

F 12. There are 5 pot tulip flowering periods.

T 13. The flowering season for potted daffodils extends from late December to mid-April.

T 14. There are sharp dividing dates between PD-1, PD-2, and PD-3.

F 15. The optimum cold-week requirement for most cultivars of daffodils is approximately 12-14 weeks.

F 16. Daffodils used for forcing are normally mother bulbs.

T 17. In general, few disease or insect problems are associated with the forcing of pot daffodils.

T 18. For PD-5, PD-6, and PD-7 a greenhouse forcing temperature of 60° is preferred.

F 19. Tulips should be planted 4-6 inches deep in the container for forcing a pot crop.

T 20. Artificial light is necessary in a rooting room to carry out the practices of watering and inspecting.

T 21. Within 3-5 weeks after planting, tulips should have developed roots throughout the pot.

F 22. The relative humidity of the rooting room should be between 75% and 95%.

F 23. A rooting room should not be ventilated.

T 24. The two most common diseases in the rooting room are botrytis and pencillium.

T 25. The night temperature used for forcing tulips is 55-65°F.

T 26. In general, the forcing rate for tulips is 21 days at 65°F.

T 27. In general, the forcing rate for tulips is 35 days at 55°F.

F 28. When tulips are to be stored, they should be removed from the greenhouse when they are showing color and not before.

T 29. Crocus, Iris reticulata, and Muscari are the miscellaneous bulbs most commonly grown for forcing.

T 30. Optimum cold-week requirement for forcing crocus corms is approximately 15-16 weeks.

T 31. Optimum cold-week requirement for forcing Iris reticulata is approximately 15-16 weeks.

T 32. In pot bulb forcing terminology, MB refers to Miscellaneous Bulbs.

T 33. Larger bulbs are not as susceptible to blindness and blasting as smaller bulbs.

T 31. Usually 10-12 Miscellaneous Bulbs are placed in each 4" bulb pan.

F 35. Ink Spot is not a disease problem in Iris reticulata.

UNIT H: Identifying and Controlling Pests of Horticultural Plants

PROBLEM AREAS:

1. Identifying and controlling landscape and garden pests

UNIT H: IDENTIFYING AND CONTROLLING PESTS OF HORTICULTURAL PLANTS

PROBLEM AREA: IDENTIFYING AND CONTROLLING LANDSCAPE AND GARDEN PESTS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the spring semester or early fall semester when garden pests are available. It is assumed that appropriate Core I materials in Unit H Problem Area 1 have been discussed and appropriate skills acquired.

The instructor is encouraged to collect the insect and disease specimens to be studied in class. Individual insect and disease collections should be encouraged. The estimated instructional time for this problem area is 5 to 10 days, depending on how far the teacher wishes to go in developing identification and control skills at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be 5 days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, information sheets, student worksheets, and test questions were developed by Jim Ethridge, Joliet Junior College, Charles Wanner, Lincoln-Way High School, and Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Transparency masters and the transparency discussion guide were prepared by Vocational Agriculture Service, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Pilot Test Teachers.

TEACHER'S GUIDE

I. Unit: Identifying and controlling pests of horticultural plants

II. Problem area: Identifying and controlling landscape and garden pests

III. Objectives:

1. Given four examples of turfgrass areas exhibiting diseases, the student will identify the following disease problems - (1) helminthosporium leafspot and root rot, (2) fusarium blight, (3) powdery mildew, and (4) rust.

2. Given specimens of turfgrass insects, the student will identify the following pests - (1) white grub, (2) sod webworm, and (3) chinch bug. Additionally, the student will draw a diagram of the life cycle of each insect and indicate on the cycle the best time for control.

3. Given examples of turfgrass areas damaged by insects, the student will identify the insect pest most likely to have caused the damage.

4. Given samples of damaged turfgrass areas, the student will identify four causes of poor turf that are not related to insect or disease damage.

5. Given an established turfgrass area, the student will demonstrate the proper procedure of measuring and applying turfgrass chemicals safely, in the proper concentration and at the most effective time to control weed, disease and insect problems.

6. Given ten examples of trees and shrub areas exhibiting diseases, the student will identify the following disease problems (1) root rot, (2) leaf spot, (3) powdery mildew, (4) rust, (5) anthracnose, (6) wilts, (7) fireblight, and (8) virus.

7. Given specimens of tree and shrub insects, the student will identify the following insect pests: (1) bagworm, (2) scale, (3) webworm, (4) tent caterpillar, (5) aphid, (6) maple bladder galls, (7) mimosa webworm, (8) leaf miners, (9) cicada, and (10) mealy bug.

8. Given examples of three tree and shrub insect pests (scale, aphid, bagworm) the student will draw a diagram of the life cycle of each insect and indicate on the cycle the best time for control.

9. Given examples of trees and shrubs damaged by insects, the student will identify the insect most likely to have caused the damage.

10. Given samples of damaged trees and shrubs, the student will identify the causes of the damage that are not related to insect or disease damage.

11. Given an established tree or shrub area, the student will demonstrate the proper procedure of measuring and applying tree and shrub chemicals safely, in the proper concentration and at the most effective time to control disease and insect problems.

12. Given ten insects or photographs of insects that attack flowers and vegetables, the student will identify the insect by common name.

13. Given a pest problem in a flower or vegetable garden, the student will recommend alternatives (chemical as well as other) for effective control.

14. Given ten samples of photographs of garden plants exhibiting diseases common in Illinois, the student will identify these diseases.

15. Given a garden of vegetables or flowers exhibiting different types of insect damage and disease damage, the student will demonstrate or describe the proper procedure of measuring and applying flower and vegetable chemicals safely, in the proper concentration, and at the most effective time for control of the pest.

IV. Suggested interest approaches:

1. Start each day's lesson with a plant that exhibits damage caused by a pest to be discussed in that day's lesson. Ask what could have caused the damage and how it could be corrected or prevented.

2. List on the blackboard all the plant pests the students can recall. Major areas might be insects, animals, diseases, pollution, and physiological problems.

V. Anticipated problems and concerns:

1. What are the signs and symptoms of various diseases?

2. What organisms cause diseases?

3. What names are given to the stages in an insect's life cycle?

4. How do life cycle stages affect pest control?

5. How many stages are involved in the life cycle of an insect?

6. When and where are the insect eggs deposited?

7. What conditions are most suitable for the growth and development of insects?

8. How long will an insect remain in the form that is destructive to the plant?

9. What areas will insects inhabit during each stage of the life cycle?

10. How long does it take to complete the life cycle?

11. What types of damage are caused by insects?

12. How do you distinguish between damage due to insects and other types of injury?

13. What are some specific signs and symptoms of damage due to white grub, sod webworm and chinch bug?

14. What cultural practices should be considered as possible causes of turfgrass damage?

15. Are there pests other than insects and diseases which might injure a turfgrass site?

16. What are the signs and symptoms of these types of turfgrass damage?

17. How do you distinguish these types of turfgrass injury from damage due to insects and diseases?

18. When does it become necessary to apply chemicals to control pest problems?

19. What are the different types of pesticide formulations?

20. How do you determine the concentration of a pesticide?

21. How do contact, systemic and soil sterilant herbicides act to control weeds?

22. What time of year should herbicides be applied to control specific weed problems?

23. How do you choose the proper insecticide to control problem insects?

24. What types of fungicides are used to control disease problems?

25. How do you determine the timing of fungicide and insecticide applications?

26. What kinds of information can be found on the label of a pesticide container?

27. What methods are used for the safe application of pesticides?

28. How can you determine the proper amount of pesticide to apply for a particular situation?

VI. Suggested learning activities and experiences:

1. In the classroom or in the field, have students examine plants which exhibit diseases. Work as a class to develop a list of symptoms and signs to distinguish diseases from other pest problems.

2. Conduct a "pyrethrum test" on part of the school lawn to show the presence of insect larvae.

3. Bring specimens of common insects to the classroom. Have the students examine the various insects, and determine whether the individual insects are soil inhabiting or foliar feeding and the type of damage they might inflict.

4. Tour local sites which exhibit the diseases specified in the objectives.

   Provide students with a worksheet to fill out as observations are made. Include the following items in the worksheet - 1) name of the disease, 2) type of pathogen responsible for the disease, 3) general description of the signs and symptoms, and 4) suggestions for control.

5. Bring samples of diseased turfgrasses into the classroom. Have students work individually or in small groups (2-3) to examine the samples with microscopes and/or magnifying lenses. Observations should include 1) the name of the disease, 2) description and diagram of the diseased area, 3) name of the disease-causing pathogen, and 4) suggested control measures. The life cycles of the diseases might be introduced through this exercise.

6. Tour local turfgrass areas and attempt to locate samples of turf insects and insect damage. Record the observations made during the field trip (name of insect, general description and/or diagram of the insect, description of damage, suggestions for control.)

7. Have students work individually or as a group to compile a collection of insects. A description of damage and control measures should go along with each insect.

8. Have students work in small groups to research and draw up a diagram of the life cycle of a given insect. Each group presents

their findings to the other members of the class. The presentation should include a thorough description of the insect life cycle and suggested timing for insect control measures.

9. Have each student in the class assigned the task of identifying a problem not caused by insects or disease in his or her area. The student should describe the condition, suggest causes of the problem and present some ideas for correcting the situation. A classroom discussion can be structured around the information provided by the students.

10. Invite a representative from a maintenance company to speak to the class on the topic of pest control. Prepare student questions prior to the time the speaker comes into the class.

11. Read and interpret the information on the labels of pesticides commonly used to control weeds, diseases, and insects. Have students work individually to complete a worksheet concerning pesticide labels.

12. Tour a local vegetable garden where there is a community garden plot and attempt to locate samples of pest problems. Record the observations and determine why a pest was a problem in one location and not a problem in another location.

VII. Application procedures:

1. The material presented in this problem area should be used by the students in the development of landscape and garden maintenance plans.

2. The skills and competencies developed in this problem area might be applied in an S.O.E. project related to maintenance and improvement of the home landscape.

3. Students may apply this material during a community service project directed toward the improvement of a landscape area.

4. Students will apply the material from this problem area to the maintenance of their home landscape.

VIII. Evaluation:

1. Prepare and administer an objective paper and pencil test covering the material presented in this problem area.

2. Grade the worksheets completed by the students.

3. Conduct a practical identification test using visual samples.

4. Evaluate student performance in a role-playing situation. The students act as "experts" in the area of pest problems and respond to situations presented by the teacher. Questions posed

by the teacher should test the students' knowledge of topics discussed in this problem area. (Suggestions for pest situations may be submitted by students prior to this activity and utilized by the teacher.)

IX. References and aids:

1. Information Sheets included with this problem area:

   a. "Suggested Diseases for Identification"
   b. "Suggested Insect Pests for Identification"
   c. "Selected Reports on Plant Diseases from the Plant Pathology Department, University of Illinois"
   d. "Garden Pests Symptoms and Controls"

2. University of Illinois Cooperative Extension Service:

   a. Circular 900 (Revised annually)
   b. Plant Diseases 900 - "Controlling Diseases in the Home Vegetable Garden"
   c. Circular 1150 - "Vegetable Gardening for Illinois"
   d. Special Publication #3 Revised; "Diseases of Ornamental Plants"
   e. 1982 Turfgrass Pest Control - Circular 1076
   f. Circular 1151 "Pest Control and Related Orchard Practices in Commercial Fruit Plantings"
   g. Circular 1013 "Growing Tree Fruits in the Home Orchard"
   h. Circular 1045 "Home Fruit Pest Control"

3. Illinois Natural History Survey:

   a. Circular 47 "Illinois Trees and Shrubs - Their Insect Enemies"

   b. "Insect, Weed and Plant Disease Bulletin" and "Home, Yard and Garden Newsletter." Write:

      University of Illinois
      Ag Newsletter Service
      116 Mumford Hall
      1301 W. Gregory Drive
      Urbana, IL 61801

4. United States Department of Agriculture - Home and Garden Bulletin, Number 61, 1978, "Lawn Diseases - How to Control Them."

5. University of Illinois, College of Agriculture, Vocational Agriculture Service:

   a. Subject Matter Units:

      4045a "Handling and Using Pesticides Safely"
      5005b "Controlling Tree and Shrub Insects"

5015	"Turfgrass Diseases and their Control"
5016	"Identifying and Controlling Lawn Insects"
5021	"Identifying Tree and Shrub Insects"

b. Slide Sets:

#1108-2.3 - "Diseases of the Vegetable Garden"
#1108-2.1 - "Safe Use of Pesticides Around the Home"
(Includes Student Guide)

6. Transparencies included in this Problem Area:
   a. Pest Chart
   b. Garden Pests and Control Pest Chart
7. Sample Test Questions and Teacher's Key
8. North Central Regional Extension Publication No. 45 - "Diseases of Tree Fruits"

INFORMATION SHEET

SUGGESTED DISEASES FOR IDENTIFICATION

Flower Diseases:

1. Botrytis blight
2. Damping-off
3. Powdery mildew
4. Root rot
5. Rust
6. Sclerotinnia blight
7. Wire stem

Vegetable Diseases:

1. Bacterial wilt
2. Blossom blight
3. Bulb rots
4. Damping-off
5. Leaf spot
6. Mosaic
7. Powdery mildew
8. Root rots
9. Rots of ripening fruit

Lawn Diseases:

1. Fairy rings
2. Fusarium blight
3. Helminthosporium diseases
4. Leaf smuts
5. Powdery mildew
6. Rusts
7. Sclerotinia dollar spots
8. Snow molds

Tree and Shrub Diseases:

1. Anthracnose
2. Cankers
3. Dutch elm disease
4. Fire blight
5. Cedar-apple rust
6. Apple scab
7. Verticillium wilt

Common Noninfectious Diseases:

1. Chlorosis
2. Frost cracks
3. Mechanical damage
4. Scorch
5. 2-4-D Damage

INFORMATION SHEET

SUGGESTED "INSECT" PESTS FOR IDENTIFICATION

Flower Pests:

1. Ants
2. Aphids
3. Blister beetles
4. Cutworms
5. Grasshoppers
6. Iris borers
7. Leaf feeding beetles
8. Leaf feeding caterpillars
9. Leafhoppers
10. Mealybugs
11. Scales
12. Slugs
13. Spider mites
14. Thrips
15. White flies

Tree and Shrub Pests:

1. Aphids
2. Bagworms
3. Borers
4. Cankerworms
5. Eastern tent caterpillars
6. Fall webworms
7. Galls
8. Leaf Miners
9. Mealybugs
10. Mimosa webworms
11. Mites
12. Sawflies
13. Scales
14. Zimmerman pine moths

Vegetable Pests:

1. Aphids
2. Bean leaf beetles
3. Cabbage worms
4. Colorado potato beetles
5. Corn borers
6. Cucumber beetles
7. Cutworms
8. Earworms
9. Flea beetles
10. Grasshoppers
11. Hornworms
12. Leafhoppers
13. Mexican bean beetles
14. Mites
15. Squash vine borer

Lawn Pests

1. Aphids
2. Armyworms
3. Chiggers
4. Chinch bugs
5. Cutworms
6. Millipedes
7. Sod webworm
8. White grubs

INFORMATION SHEET

SELECTED REPORTS ON PLANT DISEASES FROM THE PLANT PATHOLOGY DEPARTMENT, UNIVERSITY OF ILLINOIS

600 Walnut Anthracnose
603 Iron Chlorosis
604 Cytospora Canker of Spruce
605 Leaf Rusts of Poplars and Willows in the Midwest
606 Phomopsis Canker and Dieback of Russian Olive
607 Bacterial Blight of Geraniums
608 Virus Diseases of Geraniums
610 Black Spot of Rose
611 Powdery Mildew of Roses
615 Damping-off and Root Rots of House Plants and Garden Flowers
616 Bacterial Diseases of Dieffenbachia and Philodendron
617 Powdery Mildew of Ornamentals
618 Oak Wilt
619 Fasciation, or Leafy Gall
620 Leaf Scorch of Woody Plants

Miscellaneous

1000 The Safe Use and Toxicity of Fungicides, Bactericides, and Nematicides (being revised)
1001 Seed Treatments for Field Crops
1002 Modern Fungicides and their Uses
1003 Weather and Plant Diseases
1004 Plant Damage from Air Pollution
1006 Crown Gall
1007 Disease Reactions of Field Crop Varieties Recommended for Illinois

Nematodes

1100 Collecting and Shipping Soil Samples for Nematode Analysis

INFORMATION SHEET

GARDEN PESTS SYMPTOMS AND CONTROLS

PEST	DAMAGE OR SYMPTOM	CONTROL
I. SUCKING		
Aphids	Shriveled leaves	Contact spray or systemic stomach poison
Scale	Brown, Black Gray Shells	Spray winter or summer, hand pick
Mealy bugs	Yellow leaves, waxy white axles of leaves	Contact spray
Spittle bugs	Spittle	Contact spray
Red Spider Mites	Small spots of discoloration, silvered leaves	Contact spray
Leaf Roller	Nibbled leaves	Hand pick
Cuban Laurel Thrip	Folded leaves Red-blotch	Systemic stomach poison
Thrips	Leaf streaks Spread virus	
II. CHEWING		
Fullers Rose Beetle	Eat leaf margins	Contact dust
Sow and Pill Bugs	Dead and tender leaves	Bait
Snails, Slugs	Slime trails, nibbled leaves low on plant	Baits
Grasshoppers	Cut leaves--late summer	Stomach poison
Caterpillars	Cut leaves	Contact poison, Biological control
Earwigs, beetles, Weevils	Nibbled leaves high on plant	Baits

GARDEN PESTS SYMPTOMS AND CONTROLS (CONT.)

PEST	DAMAGE OR SYMPTOM	CONTROL
III. SOIL PESTS		
Sod webworm	Brown patches in lawn	Contact and stomach poisons
Cutworms	Stems cut	
Root Knot Nematode	Galls on roots; dies	Nematocide
IV. MISCELLANEOUS		
Borers	Sawdust, wilted leaves	Stomach poison
Leaf Miner Fly Maggot	Mined leaf	Contact and stomach poisons
Earthworms	Small mounts or castings on lawn	
Ants	Herd Aphid, Mealy Bug	Baits
LARGER PESTS		
Pets, (dogs, cats)	Urine, Scratch lawn	Train pet, design for pet, give up gardening
Gophers, ground squirrel, mole	Tunnels	Consult county Agricul-cultural Commissioner
Skunks	Scratched turf	Grub-free lawn
People	Nibbled leaves Trampled plants	Eradication not feasible Education possible
V. FUNGUS		
Powdery mildew	White or grey powder; leaves distorted	Sulfur (spray or powder) below 85 degrees; reduce humidity; thin plants
Botritis Grey mold	Blackened soft; decay on flowers and stems	Fungicide, reduce humidity; remove diseased parts

Rust	Yellow; orange postules under leaves; mottled	Fungicide, clean culture; reduce humidity
Anthracnose	Dieback; early leaf drop, Brown lesions, cankers	Fungicide, Prune diseased portion
Leaf Spot Leaf Blight	Shot holes; yellow or red brown spots on leaves	Fungicide, Clean culture; prune diseased parts
Wilts Verticillium	Root damage; top wilts; prune diseased partial recovery	Fumigate soil before planting; fertilize
Root rots	Upper root damage (50%); top wilts; alkaline soil	Acidify soil (sulfur, iron); prune back
Root rots Water mold	Yellowing, droopy leaves	Fungicide drench, improve drainage
Damping off Seed collapse	Seedling failure before sprouting, emerging or post emergence	Seed fungicide; sterile soil; drench soil with fungicide

VI. BACTERIA

Fire blight	Sooty dark pustules on bark, burned foliage on a branch	Bordeaux, Streptomycin; spray on blossoms or prune well below infected portion; burn foliage and sterilize pruners after each cut

VII. VIRUS

Mosaic	Mottled or yellowing, stunted leaves; variegated or "breaking" of flower	Control aphids, leaf hoppers, white flies. (No chemical control)

STUDENT WORKSHEET

OBSERVATION OF TREE, SHRUB, FLOWER, VEGETABLE, AND TURF INSECTS

Location	Description of damage to turfgrass	Description and/or drawing of insect pest	Name of insect	Control methods	Time of control

STUDENT WORKSHEET

OBSERVATION OF TREE, SHRUB, FLOWER, VEGETABLE, AND TURF DISEASES

Location	Signs and Symptoms of Disease	Name of the Disease	Type of Organism Causing Disease	Preventive Measures	Chemical Control

WORKSHEET

INTERPRETING INFORMATION ON PESTICIDE LABELS

1. Name of pesticide ______________________________
2. Name of manufacturer __________________________
3. Weight or volume of pesticide ____________________
4. Type of pesticide: Insecticide ________________
   Herbicide ________________
   Fungicide ________________
5. Time of application: Preemergence ______________
   Postemergence ______________
6. Weeds, Insects or Diseases that can be controlled ________________
   ____
   ____
   ____
   ____
   ____
7. Type of formulation: Solution ________________
   Emulsifiable Concentrate ________________
   Wettable Powder ________________
   Granular ________________
8. Concentration: Percent of active ingredients ________________
   Pounds of active ingredient per gallon ________________
9. Precautions:
   a. What danger(s) does the pesticide present to humans and/or animals?
   b. Areas where the pesticide should not be used.
   c. Proper method of disposal of empty container.
   d. Suggestions for pesticide storage.
10. Application:
    a. Recommended time of application (time of year).
    b. Recommended rate of application.
    c. Suggested methods for application.

LABORATORY EXERCISE

THE PYRETHRUM TEST

Materials:

Water-soluble pyrethrum extract

Water

Sprinkling can

Procedure:

Place one tablespoon of pyrethrum extract in a sprinkling can with one gallon of water. (If the water-soluble pyrethrum is not available, liquid household detergents may be used in the same proportion. Those detergents with a wetting solution work best.)

Sprinkle one square yard of the turf with the solution. In two to ten minutes the worms that have been hiding in the thatch will come to the surface.

Interpretation:

Accurately measure the surface and count the worms. Try to establish a population that would warrant control measures.

Population Per Square Foot	Comment
1	Tolerant
2	Questionable
3	Use control measures

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

IDENTIFYING AND CONTROLLING LANDSCAPE AND GARDEN PESTS

True (T) - False (F)

F 1. A mite is an insect.

T 2. A termite is an insect.

T 3. An insecticide is a pesticide.

F 4. A herbicide is not a pesticide.

T 5. There is a species of aphids for almost every species of plants.

F 6. Scale insects feed on vegetation by chewing.

T 7. Some insects have piercing-sucking mouth parts.

T 8. A boxelder bug is an example of an insect that has incomplete metamorphosis.

T 9. The lady beetle is a beneficial insect.

T 10. Chemicals are the number one weapon for immediate control of insect pests.

T 11. The bagworm affecting arborvitae produces only one generation a year in Illinois.

T 12. Sprays applied in late summer after the bagworm larvae stop feeding or during the winter, are ineffective.

T 13. Adult European elm bark beetles and native elm bark beetles may carry spores of the Dutch Elm Disease fungus to healthy trees and inoculate them when feeding in the crotches of small branches.

T 14. Euonymus scale is the most important and destructive pest of euonymus.

T 15. Hickory trees heavily infested with Hickory Bark Beetles should be cut down during the winter to destroy overwintering grubs.

F 16. Maple bladder-gall mites overwinter on the leaves of the maple tree then migrate to the maple bark in the spring.

T 17. Pine bark aphids themselves are inconspicuous, but an infestation is easily recognized by the splotches of cottony substance they produce.

T 18. Damage to oaks by galls is rarely serious enough to justify spraying. Since galls provide protection for the insects inside, sprays applied after the galls develop are ineffective.

T 19. Control of soil-inhabiting insects is best achieved by drenching the insecticide into the soil.

F 20. Powdery mildew is a bacterial disease which first appears as small patches of white to light dusty gray growth on the leaves and leaf sheaths.

T 21. One of the most characteristic symptoms of Fusarium blight is a circular, donut-shaped area, up to 3 feet in diameter with apparently healthy grass in the center. (a "frogeye" pattern)

T 22. Acti - dione - Thiram is a fungicide that is recommended for the control of rust.

F 23. In mild weather, white grubs are generally found 15-20 inches below the surface of the lawn.

T 24. Large numbers of moths flying above the grass at dusk is a sign of the presence of sod webworms.

F 25. Chemical control of sod webworm is most effective just before the larvae enter the pupa stage.

F 26. Chinch bug damage to turfgrass is caused by larvae which inhabit the soil and feed on roots.

T 27. Dursban is an insecticide recommended for the control of Chinch bug.

T 28. Many of the fungi which attack turfgrasses reproduce through microscopic structures called spores.

F 29. Frequent, light watering of turfgrasses will not result in any noticeable damage to the site.

T 30. A condition that looks like disease may result from mowing too closely or too frequently.

T 31. Fertilizer and lime application rates should be considered when trying to determine the cause of turfgrass damage.

F 32. After you have opened a pesticide container, it is a good idea to transfer the material to another container for storage.

F 33. It is alright to wear short pants and short-sleeved shirt when applying a pesticide on a hot summer day.

T 34. If a pesticide is swallowed or gets in the eyes, you should look at the label on the pesticide container for first aid instructions.

T 35. Vigorously growing vegetables are more resistant to disease than those that are not growing vigorously.

T 36. Mulching can keep down soilborne diseases.

F 37. Rotating vegetable crops does little for the prevention of disease.

F 38. Vegetable residues should be left on the garden each year to improve the soil.

F 39. All insects found in a garden should be destroyed.

T 40. Harmful insects are repelled from gardens surrounded by marigolds.

F 41. One of the most serious diseases in a garden is caused by nematodes.

F 42. Fungicides often control harmful insects.

Multiple Choice

C 1. The best measure to prevent disease in the garden is:

a. to spray once a week
b. to spray once a month
c. to grow resistant varieties
d. to grow all one kind of vegetable

C 2. Which of the following is a harmful insect?

a. parasitic wasp
b. aphis lion
c. leafhopper
d. lady beetle

C 3. Which of the following is a helpful insect?

a. slugs
b. cucumber beetles
c. golden-eyed lacewing fly
d. cutworms

D 4. Diseases may be caused by:

a. fungi
b. bacteria
c. viruses
d. all of the above

A 5. Blossom drop may be caused by:

a. extreme weather conditions
b. praying mantis
c. a poor seedbed
d. rotating vegetables

_D_ 6. The stages of complete metamorphosis or development are:

A. egg, nymph, adult
B. egg, nymph, pupa, adult
C. egg, larva, adult
D. egg, larva, pupa, adult

_D_ 7. Different kinds of insect mouthparts are:

A. siphoning and lapping
B. chewing and sponging
C. piercing-sucking and sucking
D. all of the above

_A_ 8. Systemic poisons kill insects by:

A. The insects feeding on the chemical from the sap of the plant which in turn acts as a stomach poison.
B. contact
C. attacking the nerve centers
D. all of the above

_B_ 9. To detect the presence of insects before they cause serious damage to valuable trees and shrubs, you should examine the plants:

A. daily during the growing season
B. at least once a week during the growing season
C. once a month during the growing season
D. none of the above, because you should spray biweekly

_B_ 10. The following is an insect:

A. tick
B. chinch bug
C. mite
D. all of the above

_A_ 11. An example of a beneficial insect is the ____________________.

A. praying mantis
B. thrip
C. may beetle
D. carpenter ant

_D_ 12. Characteristic of nymphs:

A. hatched from eggs
B. go through a series of molts
C. look like the adult insect
D. all of the above

_C_ 13. Insect reproduction without fertilization is known as:

A. entomology
B. metamorphosis
C. parthenogenesis
D. nematoditis

_D_ 14. Destructive insects may be affected by:

A. parasites
B. predators
C. pathogens
D. all of the above

_D_ 15. A cultural control of insect pests:

A. spray tree with systemic or contact poison
B. use adequate fertilizers
C. select vigorous healthy plants
D. both B and C

_D_ 16. What insecticide has been used to control fall webworm?

A. carbaryl
B. diazinon
C. malathion
D. all of the above

_C_ 17. To prevent your trees and shrubs from being severely damaged or destroyed it is suggested that:

A. you must develop a thorough knowledge of the insect pests
B. you leave all problems to professionals
C. you have at least an elementary knowledge of insect pests and the ways they can be controlled
D. you call the state eradicationist

_D_ 18. Another method(s) for controlling pests besides the use of insecticides is:

A. varietal selection
B. hand picking
C. tree pruning
D. all of the above

_A_ 19. A sign of mimosa webworm infestation on locust trees is:

A. skeletonized leaflets
B. red leaves
C. cottony masses on the trunk of the tree
D. all of the above

B 20. To prevent trees and shrubs from being damaged or destroyed:

A. Chemicals must be used infrequently and only as a last resort to control insects.
B. For most insects you must rely on an insecticide.
C. Insecticides should be used on each life cycle of the insects.
D. A and C only

Completion (Write the appropriate word or words to complete the statements.)

1. Most borers that attack trees or shrubs are the larvae of beetles or moths.
2. Mites are especially destructive to evergreens.
3. Aphids have sucking mouthparts.
4. Scale insects are small and inconspicuous, and are likely to be overlooked until the branches of infested trees or shrubs are encrusted with them.
5. Heavy infestations of aphids usually produce a noticeable amount of honeydew, on which sooty mold may grow.
6. Avoid repeated or prolonged contact of insecticide with your skin.
7. An antidote is a remedy used to counteract the effects of a poison.
8. A parasitic insect is one that lives in or on the body of another insect.
9. An insect may be defined as a small invertebrate animal with three body regions and six jointed legs.
10. To detect the presence of insects before they cause serious damage to valuable trees and shrubs, you should examine the plants carefully at least once a week during the growing season.
11. Two pests that feed on the leaves of the tree of heaven are cynthia moth and ailanthus webworm.
12. Because only the male adult flies, infestations of bagworms are spread principally in the larvae and egg stages.
13. Two insect pests of walnut trees are: A. Walnut caterpillar; and B. Black walnut curculio.
14. This insect as a beetle feeds on the foliage of a wide variety of trees, shrubs, vines, and other plants. It is a ravenous feeder that occurs in great hordes. Both male and female adults are principally metallic green in color and about a half inch in length. Each has white spots on the top of the abdomen. It is the Japanese beetle.

15. Unsightly webs enclosing one or more branches of an ash in the early fall are signs of a ravenous colony of hairy caterpillars commonly known as the _fall_ _webworms_.

16. Of all the leaf-feeding pests that attack shade and woodland trees, the caterpillar of this insect is the most destructive. It feeds on nearly all deciduous trees, and except in the early stages of its development, on many evergreens. It is the _gypsy_ _moth_.

17. The four life cycle stages of the Japanese beetle are:

A. _egg_
B. _larva or grub_
C. _pupae_
D. _adult_

18. This insect is probably the best known of the scale insects. It is widely distributed and is a serious pest on many trees and shrubs. Heavy infestations encrust limbs and branches causing them to die. Scraping an infected branch with a thumbnail squeezes the yellow juice from the saclike insects beneath the gray to black, circular shells. This insect is the _San_ _Jose_ Scale.

19. The larvae of these insects are often seen as colonies of caterpillars feeding on pine needles. They are especially injurious to young pines, which may be killed in one defoliation. These insects are _sawflies_.

Essay Questions

1. List and describe practices other than using insecticides that may help to avoid or reduce destruction by insect pests.

(answer, 1st pararaph, p. 26 of VAS Unit 5005b)

2. Describe five ways that insects may damage trees and shrubs.

(answer, 1st paragraph, right column, p. 1 of VAS Unit 5005b)

3. Relate the safety precautions that must be taken with insecticides so they will not be injurious to man and animals.

(See page 8 of VAS Unit 5021.)

4. How do you tell a termite from an ant?

(See page 3 of VAS Unit 5021.)

Short Answer

1. Diseases found on turfgrass areas are caused by:

   A. Bacteria
   B. Virus
   C. Fungi

2. List three symptoms that you would expect to see on a turfgrass area that is infected with the Helminthosporium fungus.

   1. Reddish-brown spots on leaves and stems
   2. Leaves shrivel
   3. Roots discolor and rot

3. Draw and label a diagram showing the life cycle of a white grub. Underline the stage in the life cycle when control measures would be most effective.

Larva

Egg　　　　　　Pupa

Adult (Beetle)

4. Describe the damage that you would expect to see on a turfgrass area infested with sod webworm.

   Brown spots on the turf, and blades of grass that have been clipped near the base of the leaf.

5. Indicate how the following insect pests would damage the turf. Match the damage with the insect pest.

1. White grub	A	A. Infest the soil and attack plant roots.
2. Sod webworm	C	B. Suck plant juices.
3. Chinch bug	B	C. Feed on plant leaves and stems.

6. Some white grubs will remain in the soil for _B_ years, and may feed on grass roots for several seasons.

   A. 5-7
   B. 2-3
   C. 15-20

7. The principal defense against turfgrass pests is _B_.

   A. Chemical pesticides
   B. Proper irrigation, mowing and fertilization practices
   C. The introduction of predators that destroy the pests

8. Herbicides can be classified according to the nature of their activity on plants. _Contact_ herbicides kill plant parts covered by the chemical. If the chemical is absorbed by the plant structures and moves throughout the plant, it is a _systemic_ herbicide.

9. Describe the timing for application of the following types of herbicides, and give one example of each type.

   1. Preemergence -

      Chemicals applied to the soil to stop the growth of seed.
      DACTHAL

   2. Postemergence -

      A chemical that is applied to emerged plants.
      2,4-D

10. List three types of pesticide formulations.

    1. Solution
    2. Wettable powder
    3. Granular

11. List five precautions that you would observe when using a pesticide.

    1. Do not apply if there is a danger of drift to other areas.
    2. Wash thoroughly after handling a pesticide.
    3. Always leave pesticide in original container.
    4. Should be fully clothed when applying pesticides.
    5. Read and heed all precautions and directions on the label.

12. Examine the sample pesticide label and provide the following information:

    A. Concentration of the pesticide ______________.

    B. Areas where the pesticide should not be used.

    C. Type of pest this chemical will control.

    D. Identify the degree of danger this pesticide presents to humans.

13. Identify the four turfgrass diseases shown in the numbered samples.

    1.
    2.
    3.
    4.

14. Identify the three turfgrass insects shown in the numbered samples.

    1.
    2.
    3.

UNIT I: Urban Animals

UNIT I: URBAN ANIMALS

RATIONALE FOR OMITTING URBAN ANIMALS IN CORE II

A unit on urban animals which consisted of two problem areas was included in Core I. The original outline for Core II included additional problem areas on urban animals but a decision to drop them from the Core was made. Problem areas on animals do have a place in an urban agriculture program because occupations which require knowledge and skills related to urban or companion animals are important. However, the following rationale was used to justify the dropping of urban animal problem areas from Core II:

1. The development of local short- and long-range plans for vocational education programs in agriculture and the reimbursement of agricultural occupations programs is based on taxonomic areas of agriculture as defined by the U.S. Department of Education. Mixing horticulture and animals in the core curriculum may suggest to some schools that their local programs can follow this pattern and be approved for reimbursement.
2. A reasonable case can be made for including both horticulture and animals in Core I and II if these two years are to be taught as the occupational orientation phase of the agriculture occupations program. However, since many urban schools in Illinois are presently offering only two or three years of agriculture/horticulture, it is reasonable to assume that, at least in some schools, Core I and/or Core II may be used primarily for the skill development phase of the agricultural occupations program.
3. Accordingly, the Illinois Joint Staff in Agriculture Education recommended that animals and horticulture not be mixed in Core II or Core III.

Schools which need to offer an urban agriculture program which includes more than the horticulture area should refer to the Rural Agriculture Program Core Curriculum for alternative areas of instruction.

Schools which need assistance in developing the agricultural occupations program according to quidelines and requirements established by the Illinois State Board of Education, Department of Adult, Vocational and Technical Education are encouraged to contact their Regional Administrator or the Occupational Consultants for Agriculture.

UNIT J: Soil Science and Conservation of Natural Resources

PROBLEM AREA:

1. Fertilizing horticultural crops

UNIT J: SOIL SCIENCE AND CONSERVATION OF NATURAL RESOURCES

PROBLEM AREA: FERTILIZING HORTICULTURAL CROPS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students enrolled in a horticultural occupations program. The recommended time for teaching this problem area is 7 to 10 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. Students received basic instruction on growing horticultural crops and soil testing prior to the teaching of this problem area.
2. Students have received instruction in basic chemistry, or the horticulture teacher is planning approximately 5 days instruction time for basic chemistry.
3. Instructors may wish to divide this problem area into sections which can be taught at different times of the year and/or to different classes.

Teachers are encouraged to conduct a local search to locate other supplementary materials. The items in this problem area are for reference or modification as the teachers adapt this material to their local situation.

CREDIT SOURCES:

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The teacher's guide, worksheets, transparency discussion guide, jobsheets, and test questions were developed by Jerry Pepple and Ron Biondo, Department of Vocational and Technical Education, University of Illinois. The transparency masters were prepared by Vocational Agriculture Service, University of Illinois. The student worksheets and sample test questions were developed from materials originally prepared by Brian Cirks, Alexis High School, Jerry Kuykendall, Maroa-Forsyth High School, and Warren Wagner, Department of Agricultural Education, Pennsylvania State University.

Suggestions and guidance in the development of these materials were provided by the Rural Core Curriculum Field Test Teachers.

TEACHER'S GUIDE

I. Unit: Soil science and conservation of natural resources

II. Problem area: Fertilizing horticultural crops

III. Objectives: At the close of this problem area students will be able to--

1. Identify the common hunger signs of horticultural crops.
2. Identify the major plant nutrients and their functions in plant growth.
3. Identify the secondary and micro-nutrients necessary for plant growth.
4. Develop an understanding of how nutrients are absorbed.
5. Determine fertilizer ratios used in commercial horticultural fertilizers.
6. Identify the common sources of the major plant nutrients and their methods of application.
7. Identify factors that determine the rate of fertilization.
8. Calculate the amount of fertilizer to apply to a given situation.
9. Identify the difference between organic and inorganic fertilizers.

IV. Suggested interest approaches:

1. Take a walking field trip pointing out trees with possible iron chlorosis problems, turf needing fertilization and other fertilizer deficiencies as well as lawns, trees, shrubs, and crops showing good healthy growth.
2. Identify class members, who are growing plants for their S.O.E. programs. Have them describe the fertilizer program they are using on the plants.
3. Organize a field trip to a fertilizer dealer, and have a representative explain the fertilizer mixes and how they determine a proper fertility program. Take small vials and obtain samples of the fertilizer mixes to use later in class for identification and discussion.
4. Invite local greenhouse growers or golf course managers (FFA Alumni or Horticulture Advisory council member) to class and have them explain the process they use to plan a fertility program. Possible items to discuss are:

    a. How do you determine the amount to apply?

    b. When do you apply the fertilizer?

    c. What form of fertilizer do you use (dry, liquid, gas)?

    d. What fertilizer ratios do you use?

5. Cut out fertilizer advertisements found in horticulture magazines and pass them around the class. Have students select the brand they would purchase. Identify the specific claims and information contained in the advertisements.

6. Have the students name the fertilizers used in their home situations.

7. Bring into class several plants showing nutrient deficiencies and have a class discussion as to what caused the problems.

8. Separate the class into small groups and have them identify the plant nutrients they feel are essential for proper plant growth. Let each group briefly report their conclusions to the rest of the class.

V. Anticipated problems and concerns of students:

1. What is a fertilizer?

2. What nutrients are in a fertilizer?

3. Where do we get fertilizers?

4. How do plants take up nutrients?

5. What nutrients are required by plants?

6. What are the common signs of nutrient deficiency?

7. What is the meaning of numerals on a fertilizer label?

8. What causes the difference in the price for different fertilizers?

9. How can we determine what is the best buy for a specific situation?

10. What is a tissue test?

11. Are limestone and gypsum considered fertilizers?

12. Where do plants get their vitamins?

13. What happens to the fertilizer that is not used by the plant?

14. What factors determine the rate of fertilization?

15. What are the effects of the primary, secondary and trace elements?

16. What factors determine inorganic fertilizer selection?

17. How do you apply fertilizers?

18. What is a soluble fertilizer?

19. What are slow-release fertilizers?

20. What are fast-release fertilizers?

21. When should fertilizers be applied?

22. What is pH and how does it affect nutrient availability?

23. What are organic and inorganic fertilizers?

24. How can soil pH be adjusted?

25. What are soluble salts?

26. Where can I get information concerning the amount of fertilizer to apply to a crop?

27. What does lime do?

IV. Suggested learning activities and experiences:

1. Organize the identified problems and concerns into topic areas, such as:

   a. Major plant nutrients,
   b. Secondary plant nutrients,
   c. Micronutrients, and
   d. Soil pH.

   Identify tentative answers to the questions and problems through class discussion.

2. Collect soil samples from turf areas, vegetable gardens, and pot chrysanthemums; have them analyzed and discuss the results with the class.

3. Using the transparencies and the transparency discussion guide included in this problem area, discuss nitrogen, phosphorus, and potassium. Also discuss the secondary nutrients and the micronutrients.

4. Discuss fertilizer analysis and the calculations to determine the amounts of nitrogen, phosphorus and potassium.

5. Have the students read the Horticulture Facts Sheet "Fertilizing Your Vegetable Garden."

6. Use the transparency provided to discuss the methods of fertilizer application.

7. Have the students complete the Worksheets "Major Plant Nutrients," "Fertilizer Calculations," and "Calculate Application Rates of Fertilizer."

8. Discuss pH, what effects it has on plant growth, and how it can be adjusted. Use the transparencies provided.

9. Have the students complete the Worksheet "Micronutrients and pH."

10. Have students collect various fertilizer bags. Identify the elements, % analysis, and ratios contained in the various fertilizers. Obtain the local current fertilizer price and calculate the cost per pound of nitrogen, phosphorus, and potassium. Relate these costs to selected greenhouse systems and house plants.

11. Have the students determine required amount of fertilizer for given areas:

    a. 10,000 sq. ft. lawn.
    b. 1,000 sq. ft. vegetable garden.
    c. 1 large tree spread 30 ft. in diameter.
    d. 1 crop of 400 pots of poinsettias.

12. Have the students read the Horticulture Facts Sheet "Fertilizer Recommendations for Turf."

13. Mark out a lawn area on the school grounds, properly fertilize it and then compare it to the rest of the school lawn area. Compute the cost of doing the entire lawn area of the school. Refer to the Job Sheet "Comparing the Effect of Fertilizers."

14. Set up a demonstration with pot chrysanthemums and fertilizations rates. Subject three identical plants to different conditions; no fertilizer, the recommended fertilization rate, and double the recommended fertilization rate. Discuss the results with the class.

15. Develop a fertility program for the school's land laboratory or a student's S.O.E.P.

16. Have the students fertilize trees on the school grounds. Use the Job Sheet "Fertilizing Trees" provided in this problem area.

17. Demonstrate how the fertilizer injector in the greenhouse is to be used. Have the students follow a fertilization schedule in the greenhouse. Use the Job Sheets "Fertilizing Contrainer Grown Stock and Bedding Plants" and "Fertilizer Application."

18. Take a walk with the class around the neighborhood. Point out and discuss nutrient-deficient plants (rhododendrons, Pin Oaks, Silver Maple, etc.).

VIII. Application procedures:

1. Fertilization skills learned should be applied to student S.O.E. programs, the school land laboratory and greenhouse, and the home situation.

2. An understanding of fertilization will aid students employed in the horticulture industry.

IX. Evaluation:

1. Prepare and administer a pencil and paper test using the Sample Test Questions as possible test items.

2. Collect and grade worksheets.

3. Evaluate student's performance on job sheets.

4. Evaluate performance on an assigned fertilization project or experiment.

X. References and aids:

1. University of Illinois, College of Agriculture Cooperative Extension Service.

a. Horticulture Facts Sheets:

TG-2-79F	"Fertilizer Recommendations for Turf"
VC-5-80	"Organic Gardening and Soil Fertility"
VC-9-80	"Fertilizing Your Vegetable Garden"
NC-3-80	"Iron Chlorosis of Woody Plants: Symptoms and Control"

b. Circulars:

1150	"Vegetable Gardening for Illinois"
1082	"Illinois Lawn Care and Establishment"
1186	"1981-1982 Illinois Agronomy Handbook"

2. University of Illinois, Vocational Agriculture Service Subject Matter Unit 5003, "Fertilizing and Watering Shade and Ornamental Trees" 12 pages

3. Transparencies and Transparency Discussion Guide included in this problem area.

4. Bedding Plants, John W. Mastalerz, Published by the Pennsylvania Flower Growers, Chapter 15, "Fertilization" written by John W. White.

5. Information Sheets included in this problem area:

    a. "Fertilizers"
    b. "Adjusting Soil pH"

INFORMATION SHEET

FERTILIZERS

		Nitrogen Average % N	Phosphoric Acid Average % P_2O_5	Potash Average % K_2O	Speed of avail.	Reaction
1.	Dried Blood	13	1.5	.8		
2.	Milorganite	5	2	0	Med. Quick	Acid
3.	Tankage	8-10	5-12	0	Med. Quick	Neutral
4.	Bone Meal Steamed	2-4	22-25	0	Very Slow	Alkaline
5.	Bone Meal Steamed	1-2	22-30	0	Slow	Alkaline
6.	Sheep Manure	2-3	1	1-2	Slow	
7.	Sewage Sludge	3	2.5	.4		

ORGANIC VEGETABLE AMMONIATES

		Nitrogen Average % N	Phosphoric Acid Average % P_2O_5	Potash Average % K_2O	Speed of avail.	Reaction
1.	Cotton Seed Meal	8	2	2	Slow	Acid
2.	Tobacco Stems	2	0	8	Slow	Variable
3.	Wood Ashes (Hardwood)	0	2	8	Slow	Alkaline
4.	Wood Ash. (Softwood)	0	2	4	Slow	Alkaline
5.	Linseed Meal	5	2	2	Slow	Acid
6.	Castor Bean Meal	5	2	@	Slow	Acid
7.	Soybean Meal	6	3	1	Slow	Acid
8.	Peat Soil	2-4	0	0	Slow	Acid to Neutral

CHEMICAL INORGANIC AND MANUFACTURED AMMONIATES

		Nitrogen Average % N	Phosphoric Acid Average % P_2O_5	Potash Average % K_2O	Speed of avail.	Reaction
1.	Ammonium Chloride or (Muriate of Ammonium)	26	0	0	Quick	Acid
2.	Ammonium Sulphate	20	0	0	Quick	V.Acid
3.	Ammonium Nitrate	35	0	0	Quick	Acid
4.	Nitrate of soda (Sodium Nitrate)	16	0	0	V.Quick	Alkaline
5.	Muriate of Pot. (potas. Chlorate)	0	0	50	Quick	Neutral
6.	Potassium Phosphate	0	15	40		
7.	Potassium Nitrate	12	0	40		Alkaline
8.	Rock Phosphate	0	25	0	V.Slow	Alkaline
9.	Sulphate of Potash	0	0	50	Quick	Neutral
10.	Super Phosphate	0	20	0	Slow	Neutral
11.	Triple Phosphate	0	45	0	Med.Slow	Neutral
12.	Ammophos #1(Ammonium)	10	50	0	Quick	V.Acid
13.	Ammophos #2(Phosphate)	15	20	0	Quick	V.Acid
14.	Calcium Nitrate	15	0	0	Quick	Alkaline

	Nitrogen Average % N	Phosphoric Acid Average % P_2O_5	Potash Average % K_2O	Speed of avail.	Reaction
15. DiAmmonium Phosphate	20	53	0	Quick	Alkaline
16. Mono Ammonium Phosphate	12	60	0	Quick	V.Acid
17. Sodium Nitrate	16	0	0	V.Quick	Alkaline
SYNTHETIC ORGANIC NITROGENS					
1. Urea	45	0	0	Quick	Acid
2. Urea-Formaldehyde	38	0	0	Slow	Acid
3. Cyanamid	20	0	0	Quick	Alkaline
COMPLETE FERTILIZERS					
5-10-15	5	10	5	Rapid	—
12-12-12	12	12	12	Rapid	—
20-20-20	20	20	20	Rapid	—

INFORMATION SHEET

ADJUSTING SOIL pH

Pulverized Limestone Recommendations[1,2]

Soil pH	SOIL TEXTURAL CLASS Sand 1000 sq. ft.	Acre	Loam 1000 sq. ft.	Acre	Clay 1000 sq. ft.	Acre
4.1 - 4.4	115	5,000	255	11,000	280	12,000
4.5 - 4.8	90	4,000	210	9,000	235	10,000
4.9 - 5.2	70	3,000	165	7,000	190	8,000
5.3 - 5.6	50	2,000	115	5,000	140	6,000
5.7 - 6.0	25	1,000	70	3,000	90	4,000
6.1 - 6.4	12	500	50	2,000	50	2,000

(1) The above recommendations are based on a 6 2/3 inch depth of soil.

(2) When the pH is below 5.3 and a new planting is being made, apply 2/3 of the limestone requirement and plow it down. Apply the remaining 1/3 and disk it into the top 2-3 inches of soil.

Acidifying Soils[1,2]

Acidifying Material	SOIL TEXTURAL CLASS Sand 1000 sq. ft.	Acre	Loam 1000 sq. ft.	Acre	Clay 1000 sq. ft.	Acre
Powdered Sulfur	4.5	196	10	440	14	600
Aluminum	30	1300	50	2178	90	3920

(1) The above recommendations are based upon lowering the pH approximately ½ of a pH unit.

(2) Mix the acidifying material thoroughly with the top 6 inches of soil.

WORKSHEET

MAJOR PLANT NUTRIENTS

Part A. Nitrogen

1. Name the three major plant nutrients and the chemical symbol for each.

Nutrient Symbol

A. ____________________ _____
B. ____________________ _____
C. ____________________ _____

2. What are the two forms of nitrogen in the soil that plants take up?

A. ____________________ _____
B. ____________________ _____

3. What are the characteristics of a plant with adequate nitrogen?

4. Commercial fertilizers are available in what three forms?

5. What factors should be conidered before purchasing fertilizer materials?

6. Determine the current price per 100 lbs. bag of the following nitrogen fertilizers:

	Price	Application
A. Ammonium nitrate	$	$
B. Diammonium phosphate (DAP)	$	$
C. Potassium nitrate	$	$

Assume you want to apply 2 lbs. of nitrogen to 1000 square feet of turf. Find the total cost of the amount of nitrogen needed for each of the 3 forms of nitrogen.

7. Why can nitrogen be applied in the fall when soil temperature drops below 50°F.

Part B. Phosphorus and Potassium

1. In what form is phosphorus expressed on a fertilizer bag? And how do you convert this to percent phosphorus?

2. In what form is potassium expressed on a fertilizer bag? And how do you convert this to percent potassium?

3. What are the major functions of phosphorus in plants?

4. What are the major functions of potassium in plants?

5. Give the percent of P_2O_5 for the following phosphorus materials.

	% P_2O_5
A. Super phosphate	______
B. Triple super phosphate	______
C. Mono-ammonium phosphate	______
D. Diammonium phosphate	______
E. Ammonium polyphosphate	______

6. Give the percent K_2O for the following potassium materials.

	% K_2O
A. Muriate of potash	______
B. Sulfate of potash	______

7. How does soil pH levels affect the availability of phosphorus and potassium?

8. Determine the ratios for the following fertilizer mixes:

analysis	= 3-9-27	3-12-12	5-20-20
ratio	= _ _ _	_ _ _	_ _ _
analysis	= 7-28-14	12-12-12	6-24-24
	= _ _ _	_ _ _	_ _ _

A. The first number in the ratio is ______________

B. The second number in the ratio is ______________

C. The third number in the ratio is ______________

9. Why are fertilizer ratios important?

10. What is the formula for determining the amount of a potash fertilizer to use?

11. Why should potash not be applied close to seeds?

WORKSHEET

MICRONUTRIENTS AND pH

1. List the elements that are classified as secondary nutrients and give their chemical symbol.

2. Why has there been an increase in reported sulfur deficiencies in the Midwest in recent years?

3. What is the primary source of sulfur in soils?

4. List the elements that are classified as essential micronutrients and give their chemical symbol.

5. Under what conditions are micronutrient deficiencies likely to appear?

6. What test is used to determine soil acidity levels?

7. How is the pH test read?

8. What are the desired pH ranges for most greenhouse soils?

9. What materials are commonly used in Illinois horticultural situations to raise pH levels?

10. What factors should be considered when selecting liming materials?

11. How is lime generally applied?

12. What materials are commonly used in Illinois horticultural situations to raise pH levels?

13. What factors should be considered when selecting acidifying materials?

WORKSHEET

CALCULATE APPLICATION RATES OF FERTILIZER

Calculate the amount of nutrients needed using different fertilizer analysis. When completed, return to the instructor for evaluation.

1. A homeowner desires to fertilize her lawn with a fertilizer (10-6-4) at a rate of 2 lbs. of Nitrogen per 1,000 square feet. How many lbs. of fertilizer would be needed to do a lawn of 10,000 square feet?

2. How many lbs. of 20-12-8 would be needed to apply 6 lbs. of Nitrogen per 1,000 square feet of a lawn of 5,000 square feet?

3. How many pounds of 20-10-10 would be needed to apply 3 lbs. of Nitrogen per 1,000 square feet on a lot 120 ft. X 100 ft. with the house consuming 1500 sq. ft. of ground space?

WORKSHEET

FERTILIZER CALCULATIONS

Compare the pounds of actual nitrogen, phosphorus, and potassium available for each fertilizer. When you have completed the problems, turn in to your instructor for evaluation. Use 100 lbs. as a base for all problems.

1. Fertilizer analysis 10-20-10

   N =

   P_2O_5 =

   K_2O =

2. Fertilizer analysis 9-45-15

   N =

   P_2O_5 =

   K_2O =

3. Fertilizer analysis 18-46-0

   N =

   P_2O_5 =

   K_2O =

4. Fertilizer analysis 13-0-44

   N =

   P_2O_5 =

   K_2O =

5. Fertilizer analysis 20-20-20

   N =

   P_2O_5 = P =

   K_2O = K =

6. Fertilizer analysis 10-6-4

   N =

   P_2O_5 = P =

   K_2O = K =

JOB SHEET

COMPARING THE EFFECTS OF FERTILIZERS

I. **Objective:** To determine how fertilizers containing different analysis affect plant growth.

II. **Materials:**

1. 100 ft. measuring tape
2. string or lime marker
3. about 25 lbs. of different fertilizer mixes such as:

    5-10-10
    13-0-44
    20-20-20
    18-46-0
    0-0-60

4. lawn fertilizer spreader.

III. **Procedure:**

1. Locate a part of the school lawn and mark out equal size plots.
2. Determine an acceptable rate of fertilizer per plot.
3. Adjust the lawn spreader according to the instruction manual.
4. Spread one analysis of fertilizer on each plot and make observations weekly.
5. Prepare a map of the fertilized plots.

IV. **Questions:**

A. How many square feet are in one acre? ____

B. How do you convert from lbs./care to lbs./100 square feet?

C. How do you determine the area of a rectangle?

D. What would be the approximate dimensions of a square which is 1/1000 of an acre 1/100 of an acre?

V. Observations: Record your observations weekly. Note the difference in growth rates, color, hardiness, etc. of the gross in each plot.

VI. Conclusions: Relate the observations you made on the plots to how you would plan a fertilizer program for your crop S.O.E.P.

JOB SHEET

FERTILIZING TREES

I. Objective:

Given appropriate tools, equipment, and supplies, the student will fertilize a tree in a sodded area.

II. Introduction:

Established trees should be fertilized only when there is a shoot growth rate of less than 8 to 12 inches per season. Deciduous trees require more fertilizer than narrow-leaved evergreens. Trees in sodded areas are usually fertilized with granular fertilizers using the punch bar or soil auger methods. Trees may also be fertilized with liquid fertilizers by inserting the fertilizer injector into the soil at the intervals and depth described in the "punch bar" method. Fertilizer "spikes" may also be used, following manufacturer's instructions.

Applications of fertilizer in late summer may stimulate growth of tender shoots that are very susceptible to freeze injury in winter. With this exception, trees in the landscape may be fertilized at any time.

III. Materials and Tools Needed:

1. Weighing scales
2. Large funnel
3. Tape measure
4. Punch bar or soil auger
5. Garden hose
6. Bucket of sand or sand and peat moss mixed
7. 10-6-6 fertilizer

IV. Procedure:

1. Mark a line around the tree two feet beyond the drip line (branch tips). A rope, garden hose, or thin line of ground limestone may be used for this purpose.

2. Usng the punch bar or soil auger, make holes 12-18 inches deep and two feet apart around the circle.

3. Using the punch bar, or soil auger make similar holes two feet apart in the area within the circle, but no closer than 2 feet from the trunk.

4. Measure the diameter of the tree 4 feet above the ground.

5. Calculate the amount of fertilizer needed. If the tree is over three inches in diameter, use 4-5 pounds of fertilizer per inch in diameter. If the tree is under three inches in diameter, use 2-3 pounds per inch in diameter.

6. Measure the fertilizer, using the scales.

7. Using the funnel to put fertilizer into the holes, evenly distribute the fertilizer to all the holes. (This usually amounts to about 1/4 cup per hole.)

8. Using sand, or a mixture of sand and peat moss, fill all the holes.

9. Thoroughly water the entire area fertilized.

10. Clean and return all tools to their proper storage place.

V. Observations:

JOB SHEET

FERTILIZING CONTAINER GROWN STOCK AND BEDDING PLANTS

I. Objective:

Given container grown trees, shrubs, and bedding plants (flower and vegetable transplants), the student will apply the proper formula fertilizer in the correct amounts to maintain the plants in healthy condition.

II. Introduction:

Outdoor plant stock in the garden center should be properly fertilized to maintain them in a healthy condition. Because of the relatively small soil volume, these plants in containers must be fertilized every two weeks until sold. Indoor plants are fertilized once a month, skipping December and January.

III. Materials Needed:

1. Two gallon bucket
2. Garden hose
3. Hozon Proportioner
4. Fertilizer, soluble
   15-15-15 or 20-20-20.
   containing a dye
5. Tablespoon

NOTE: The solution applied to the plants contains 1 ounce of fertilizer to each 2 gallons of water. The Hozon Proportioner picks up 1 gallon of concentrate for every 15 gallons of water running through the device. Since there are 8 ounces of concentrate in every 16 gallons reaching the plants, this gives a dilution of 1 ounce to each 2 gallons of water.

IV. Procedure:

1. Make sure that the soil in all containers is moist before fertilizer is applied, or the roots may be severely damaged by the fertilizer. Water the plants if needed.

2. Assemble the equipment and supplies.

3. Carefully measure one pound, or 16 rounded tablespoonfuls of the fertilizer into the bucket; add exactly 2 gallons of water (warm water, if possible); stir thoroughly to dissolve the fertilizer.

4. Connect the Hozon Proportioner to the water faucet; connect the garden hose to the Hozon Proportioner; place the pick-up tube of the Hozon into the bucket.

5. Open the water valve to about 2/3 or 3/4 of the full volume, and apply the diluted solution to the plants as though watering. (Do not use a nozzle or breaker. Any restriction in water flow causes the Hozon to dilute improperly.)

6. If the water runs clear instead of colored by the dye, it means the fertilizer concentrate has been used up and more must be made (step 3).

7. When all of the plants have been fertilized, lightly spray them with clear water over the tops to wash the fertilizer solution off the leaves.

8. Rinse the bucket and Hozon Proportioner, and put all supplies and equipment in their storage places. The fertilizer containers must be stored tightly closed, or the fertilizer will absorb moisture from the air.

VI. Observations:

JOB SHEET

FERTILIZER APPLICATION

I. Objectives:

1. To develop the ability to apply commercial fertilizers to greenhouse crops.
2. To develop an understanding of names of fertilizers, chemical analysis, and proper rates of application of various commercial fertilizers.
3. To develop an understanding of the relationship of type of fertilizer to the method of application.

II. Materials needed:

1. A balance or scale calibrated in ounces.
2. A fertilizer proportioner and other accessory equipment.
3. A quantity of complete and single-carrier fertilizers.
4. Waxed paper or other non-metallic material to measure and weigh the fertilizer.
5. A glass measuring cup.
6. Potted or bench plants that need fertilizer applications.

III. Procedure:

1. Follow the instructions for the soil test kit so that an accurate analysis of the soil may be obtained. If the soil samples were sent away from testing, following the recommendations provided by the testing service.
2. If the fertilizer is to be applied in DRY form: measure the bench and calculate the area to which the fertilizer is to be applied. Study the results of the soil test and refer to the table at the end of this demonstration to find the fertilizer that should be used. After locating the fertilizer, read across to the column that indicates the rate of application. Calculate the amount of fertilizer to use for the amount of bench area that is to be covered. Cover the platform of the scale with a sheet of waxed paper. Note the reading of the scale. Weigh out the correct amount of fertilizer needed. It may be helpful to divide this amount into smaller portions, i.e., fourths, and apply this to

an equivalent portion of the bench. When weighing, be sure to allow for the weight of the cover material that is on the platform of the scale. If potted plants are being treated, the area of the pots (or the volume of soil) will need to be calculated and the amount of fertilizer required for each pot determined.

Be sure that all of the lumps are out of the fertilizer before it is applied. Water the bench or the soil in the pots before adding the fertilizer. Pick up as much fertilizer as possible, or as much as is necessary, in a closed fist and distribute it between the rows of the plants by tipping the hand downward slightly and rolling the thumb over the first finger. If smaller amounts are used, the fertilizer can be picked up between the thumb and the first two fingers and slowly sprinkled. Do not allow any of the fertilizer to remain on any part of a plant as burning will result.

After all of the fertilizer has been applied, the soil should be sprinkled in order to dissolve the fertilizer into the soil.

3. For liquid application: Measure and calculate the area of the bench or of the pots.

   Find the fertilizer and the corresponding mixing rates in the table and calculate the amounts of fertilizer and water to use. Determine and identify the area of the bench to be covered by the quantity of mixed fertilizer. Add the fertilizer solution to the proportioner. Attach the proportioner to the water source and apply the solution to the soil. Follow instructions for the particular type of proportioner that you are using.

4. Make comparisons of the different methods of application as to differences in rate of growth, symptoms of excess or continuing deficiencies, and the general plant health for the time the demonstration is begun until after the plants have flowered. It will be necessary to continue soil testing throughout the entire period and keep the fertilization process suited to the need of the growing plants.

IV. Application:

The applicaton of fertilizer is one of the most important jobs in the greenhouse. Because of the limited amount of soil available to each plant, the soil nutrients are used much more rapidly than they would be out-of-doors. Greenhouse crops are fertilized much more frequently than field crops in order to maintain a nutrient level in the soil that is suitable for maximum production.

Either method of application is satisfactory if it is properly carried out. Dry application may have its widest use with small plants that are easier to work around. Hose-on methods may be more suitable with taller plants that may not be easily reached.

TEACHER'S KEY TO WORKSHEET

MAJOR PLANT NUTRIENTS

Part A. Nitrogen

1. Name the three major plant nutrients and the chemical symbol for each.

	Nutrient	Symbol
A.	Nitrogen	N
B.	Phosphorus	P
C.	Potassium	K

2. What are the two forms of nitrogen in the soil that plants take up?

A.	Ammonium	NH_4^+
B.	Nitrate	NO_3

3. What are the characteristics of a plant with adequate nitrogen?

   Dark green color
   Rapid vegetative growth
   Efficient use of available moisture
   Good yields
   Good quality crops
   Increases protein content
   Aids micro-organisms when decomposing
   low-nitorgen organic materials

4. Commercial fertilizers are available in what three forms?

   gas
   solid
   liquid

5. What factors should be considered before purchasing fertilizer materials?

   Amount of nutrients needed--
   Nutrient requirements of crop to be grown
   Plant population
   Expected yield
   Soil conditions--pH, drainage, organic matter
   Cost
   Availability of materials

6. Determine the current price per 100 lbs. bag of the following nitrogen fertilizers:

		Price	Application
A.	Ammonium nitrate	$	$
B.	Diammonium phosphate (DAP)	$	$
C.	Potassium nitrate	$	$

Assume you want to apply 2 lbs. of nitrogen to 1000 square feet of turf. Find the total cost of the amount of nitrogen needed for each of the 3 forms of nitrogen.

7. Why can nitorgen be applied in the fall when soil temperature drops below 40°F.

   - Bacteria have become inactive and will not convert the nitrogen to a leachable form.

Part B. Phosphorus and Potassium

1. In what form is phosphorus expressed on a fertilizer bag? And how do you convert this to percent phosphorus?

   P_2O_5 - phosphoric acid

   Multiply the percent of P_2O_5 by .44

2. In what form is potassium expressed on a fertilizer bag? And how do you convert this to percent potassium?

   K_2O - potash

   Multiply the percent of K_2O by .83

3. What are the major functions of phosphorus in plants?

   Stimulates early root growth
   Promotes rapid starts
   Hastens plant maturity
   Stimulates flowering and fruiting
   Promotes winter hardiness

4. What are the major functions of potassium in plants?

   Stimulates root development
   Promotes vigor growth
   Promotes disease resistance
   Produces strong, stiff stalks
   Essential in formation of
     starches and sugars
   Promotes winter hardiness

5. Give the percent of P_2O_5 for the following phosphorus materials.

		% P_2O_5
A.	Super phosphate	16-22
B.	Triple super phosphate	44-47
C.	Mono-ammonium phosphate	46-48
D.	Diammonium phosphate	47
E.	Ammonium polyphosphate	34-37

6. Give the percent K_2O for the following potassium materials.

		% K_2O
A.	Muriate of potash	60
B.	Sulfate of potash	48

7. How does soil pH levels affect the availability of phosphorus and potassium?

If the pH drops below 6.0, P and K both start to become unavailable to the plants.
If the pH rises above 7.0, P starts to become unavailable to the plants.

8. Determine the ratios for the following fertilizer mixes:

analysis	= 3-9-27	3-12-12	5-20-20
ratio	= 1-3-09	1- 4- 4	1- 4 4
analysis	= 7-28-14	12-12-12	6-24-24
	= 1- 4- 2	1- 1- 1	1- 4- 4

A. The first number in the ratio is nitrogen
B. The second number in the ratio is phosphorus
C. The third number in the ratio is potassium

9. Why are fertilizer ratios important?

Different blends allows you to match your cropping needs.

10. What is the formula for determining the amount of a potash fertilizer to use?

$$\frac{\text{pounds of } K_2O \text{ needed}}{\text{percent of } K_2O \text{ in the fertilizer used}}$$

11. Why should potash not be applied close to seeds?

It can cause salt injury to the seed

TEACHER'S KEY TO WORKSHEET

MICRONUTRIENTS AND pH

1. List the elements that are classified as secondary nutrients and give their chemical symbol.

Calcium	Ca
Magnesium	Mg
Sulfur	S

2. Why has there been an increase in reported sulfur deficiencies in the Midwest in recent years?

Increased use of sulfur-free fertilizer
Decreased use of sulfur as a fungicide and insecticide
Increased crop yields
Decreased atmospheric sulfur supply

3. What is the primary source of sulfur in soils?

Organic matter

4. List the elements that are classified as essential micronutrients and give their chemical symbol.

Zinc	Zn	Boron	B
Iron	Fe	Molybdenum	Mo
Manganese	Mn	Chlorine	Cl
Copper	Cu		

5. Under what conditions are micronutrient deficiencies likely to appear?

Strongly weathered soils
Course-textured soils
High pH soils
Organic soils
Soil very low in organic matter

6. What test is used to determine soil acidity levels?

pH test

7. How is the pH test read?

pH less than 7.0 is acid
pH of 7.0 is neutral
pH greater than 7.0 is alkaline

8. What are the desired pH ranges for most greenhouse soils?

Be maintained between 6.0 and 6.5.

9. What materials are commonly used in Illinois Horticultural situations to raise pH levels?

   Main source is agricultural ground limestone (lime)

   Other materials are:

   Hydrated lime
   Marl
   Chats
   Lime sludge

10. What factors should be considered when selecting liming materials?

    neutralizing power
    fineness
    price
    purpose and place of application

11. How is lime generally applied?

    by broadcasting

12. What materials are commonly used in Illinois horticultural situations to lower pH levels?

    powdered sulfur
    aluminum sulfate

13. What factors should be considered when selecting acidifying materials?

    price
    acidifying power
    fineness

TEACHER'S KEY TO WORKSHEET

CALCULATE APPLICATION RATES OF FERTILIZER

Calculate the amount of nutrients needed using different fertilizer analysis. When completed, return to the instructor for evaluation.

1. A homeowner desires to fertilize her lawn with a fertilizer (10-6-4) at a rate of 2 lbs. of Nitrogen per 1,000 square feet. How many lbs. of fertilizer would be needed to do a lawn of 10,000 square feet?

   10% N in 10-6-4

   2 lbs. ÷ .10 = 20 lbs. 10-6-4/1,000 sq. ft.

   20 lbs. x 10 = 200 lbs. 10-6-4/10,000 sq. ft.

2. How many lbs. of 20-12-8 would be needed to apply 6 lbs. of Nitrogen per 1,000 square feet of a lawn of 5,000 square feet?

   20% N in 20-12-8

   6 lbs. ÷ .20 = 30 lbs. 20-12-8/1,000 sq. ft.

   30 lbs. x 5 = 150 lbs. 20-12-8/5,000 sq. ft.

3. How many pounds of 20-10-10 would be needed to apply 3 lbs. of Nitrogen per 1,000 square feet on a lot 120 ft. X 100 ft. with the house consuming 1500 sq. ft. of ground space?

   20% N in 20-10-10

   3 lbs. ÷ .20 = 15 lbs. 20-10-10/1,000 sq. ft.

   100 x 120 = 12,000 sq. ft.

   12,000 - 1,500 = 10,500

   15 lbs./1,000 sq. ft. x 10.5 = 157.5 lbs. 20-10-10

TEACHER'S KEY TO WORKSHEET

FERTILIZER CALCULATIONS

Compare the pounds of actual nitrogen, phosphorus, and potassium available for each fertilizer. When you have completed the problems, turn in to your instructor for evaluation. Use 100 lbs. as a base for all problems.

1. Fertilizer analysis 10-20-10

   N = 10

   P_2O_5 = 20

   K_2O = 10

2. Fertilizer analysis 9-45-15

   N = 9
   P_2O_5 = 45

   K_2O = 15

3. Fertilizer analysis 18-46-0

   N = 18

   P_2O_5 = 46

   K_2O = 0

4. Fertilizer analysis 13-0-44

   N = 13

   P_2O_5 = 0

   K_2O = 44

5. Fertilizer analysis 20-20-20

   N = 20

   P_2O_5 = 20 P = 8.8

   K_2O = 20 K = 16.6

6. Fertilizer analysis 10-6-4

   N = 10

   P_2O_5 = 6 P = 2.6

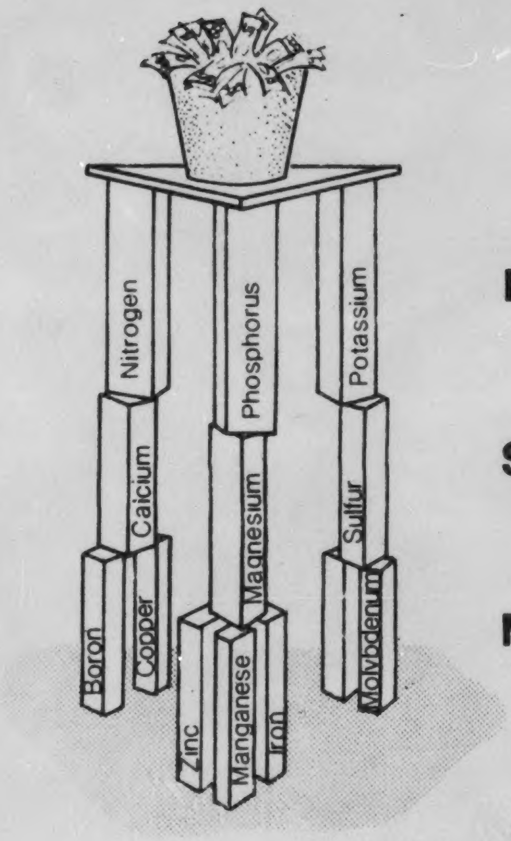
   K_2O = 4 K = 3.3

ESSENTIAL ELEMENTS

ESSENTIAL ELEMENT	SIMPLE SAYING
Carbon (C)	C.
Hydrogen (H)	H
Oxygen (O)	O
Phosphorus (P)	P
Potash (K)	K
Nitrogen (N)	N
Sulphur (S)	S
Calcium (Ca)	CA
Iron (Fe)	FE
Magnesium (Mg)	Mighty Good

C. HOPKINS CAFE Mighty Good

PROFITS CAN FALL IF ANY NUTRIENT IS SHORT


Nitrogen
Phosphorus
Potassium
Calcium
Magnesium
Sulfur
Boron
Copper
Molybdenum
Zinc
Manganese
Iron

Primary plant nutrients

Secondary plant nutrients

Micro plant nutrients

For high profits all nutrients must be present and in balance.

NUTRIENTS IN FERTILIZERS

PRIMARY

N	Nitrogen
P	Phosphorus in Fertilizer Phosphate--P_2O_5
K	Potassium in Fertilizer Potash--K_2O

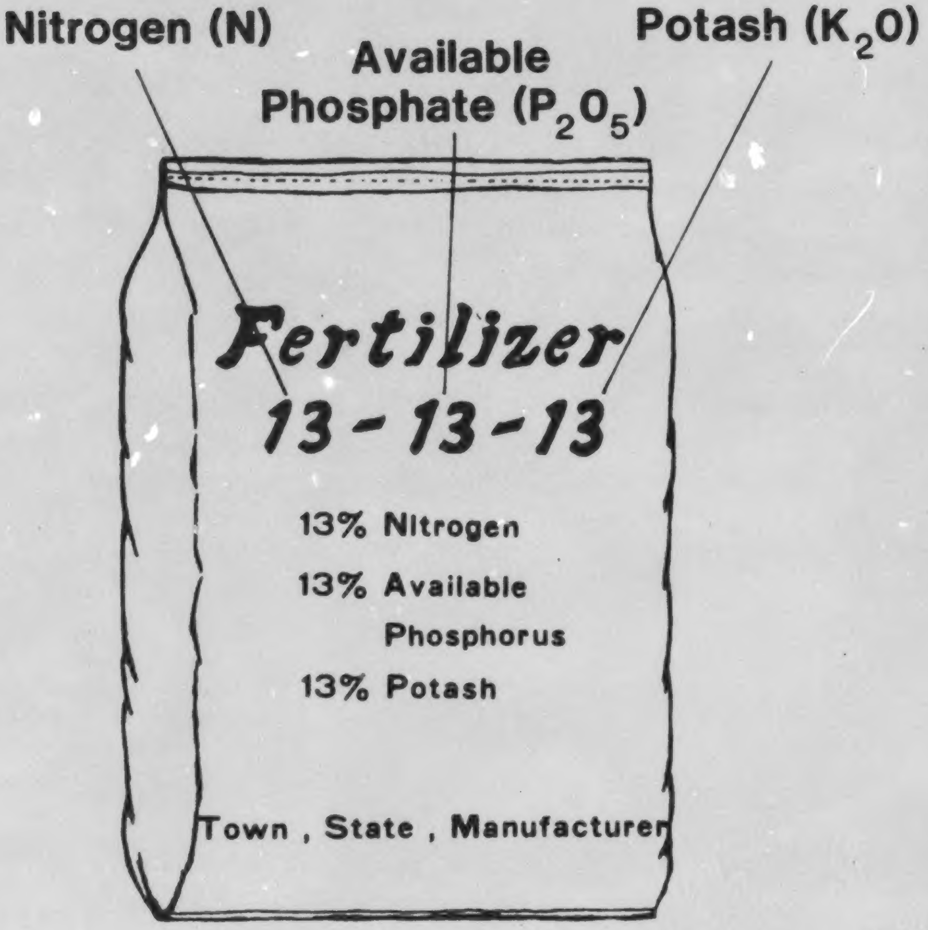
SECONDARY

Ca	Calcium
Mg	Magnesium
S	Sulfur

MICRONUTRIENTS

B	Boron
Cu	Copper
Fe	Iron
Mn	Manganese
Mo	Molybdenum
Zn	Zinc
Cl	Chlorine

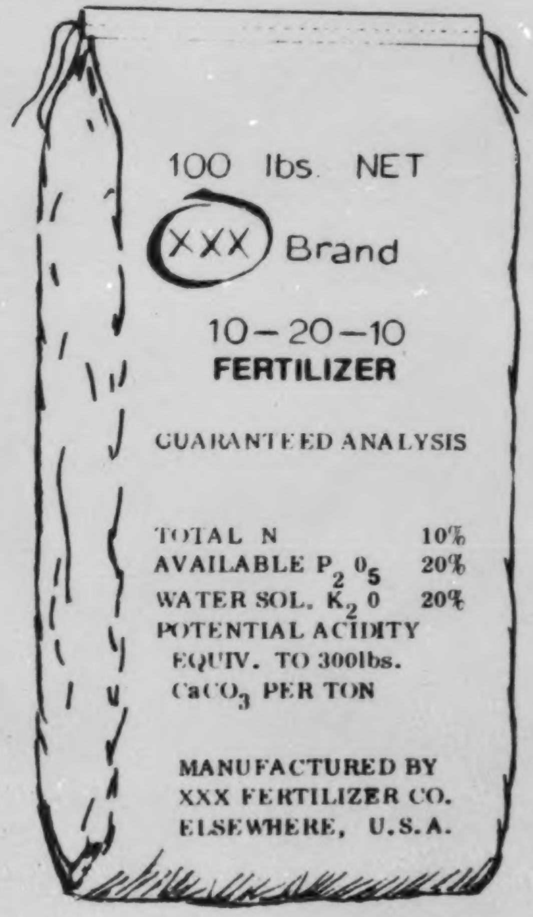
PLANT NUTRIENT BLENDS


Nitrogen (N)
Available Phosphate (P_2O_5)
Potash (K_2O)
Fertilizer
13 - 13 - 13
13% Nitrogen
13% Available Phosphorus
13% Potash
Town, State, Manufacturer

13 N — 13 P_2O_5 — 13 K_2O = 1—1—1 Ratio

13 Lbs. of Each Primary Nutrient =
39 Lbs. per 100 Lbs. of Fertilizer

INFORMATION COMMONLY FOUND ON A FERTILIZER BAG


100 lbs. NET
XXX Brand
10-20-10
FERTILIZER
GUARANTEED ANALYSIS
TOTAL N 10%
AVAILABLE P_2O_5 20%
WATER SOL. K_2O 20%
POTENTIAL ACIDITY
EQUIV. TO 300lbs.
$CaCO_3$ PER TON
MANUFACTURED BY
XXX FERTILIZER CO.
ELSEWHERE, U.S.A.

Lbs. per Bag

Name or Brand of Fertilizer

Chemical Composition Guaranteed

Acid Forming Tendency

Name & Address of Manufacturer

FERTILIZER ANALYSIS

20 - 10 - 10

20	10	10
Total Nitrogen Available	Total Phosphorus Expressed as P_2O_5	Water Soluble Potassium Expressed as K_2O

NITROGEN

FUNCTION IN PLANTS

An adequate supply:

1. Produces vegetative growth.
2. Gives dark-green color to plants.
3. Feeds soil micro-organisms during their decomposition of low-nitrogen organic materials.
4. Increases efficiency of available moisture.

HUNGER SIGNS

1. Yellowing starting at the tip and extending down the midribs of the lower leaves.
2. Slow and dwarfed growth.
3. Poor root system.

MOVEMENT IN SOIL

1. In the ammonium form, nitrogen moves very little after it is absorbed by the clay particles.
2. In the nitrate form, nitrogen moves with soil moisture; consequently, nitrate nitrogen will be more apt to leach on sandy soils than in heavier clays and clay loams since water movement will be greater.

PHOSPHORUS

FUNCTION IN PLANTS

1.Stimulates early root formation
2. Gives rapid and vigorous start.
3. Hastens maturity.
4. Stimulates blooming.
5. Gives winter hardiness.

HUNGER SIGNS

1. Stunted growth.
2. Slow maturity.
3. Low yield of fruit and seed.
4. Purpling of leaves, stems, and branches in plants.

MOVEMENT IN SOIL

Phosphorus moves very little from its point of application.

POTASSIUM

FUNCTION IN PLANTS

1. Imparts increased vigor and disease resistance.
2. Produces strong, stiff stalks.
3. Essential to the formation and transfer of starches, sugars, and soils.
4. Imparts winter hardiness to crops.

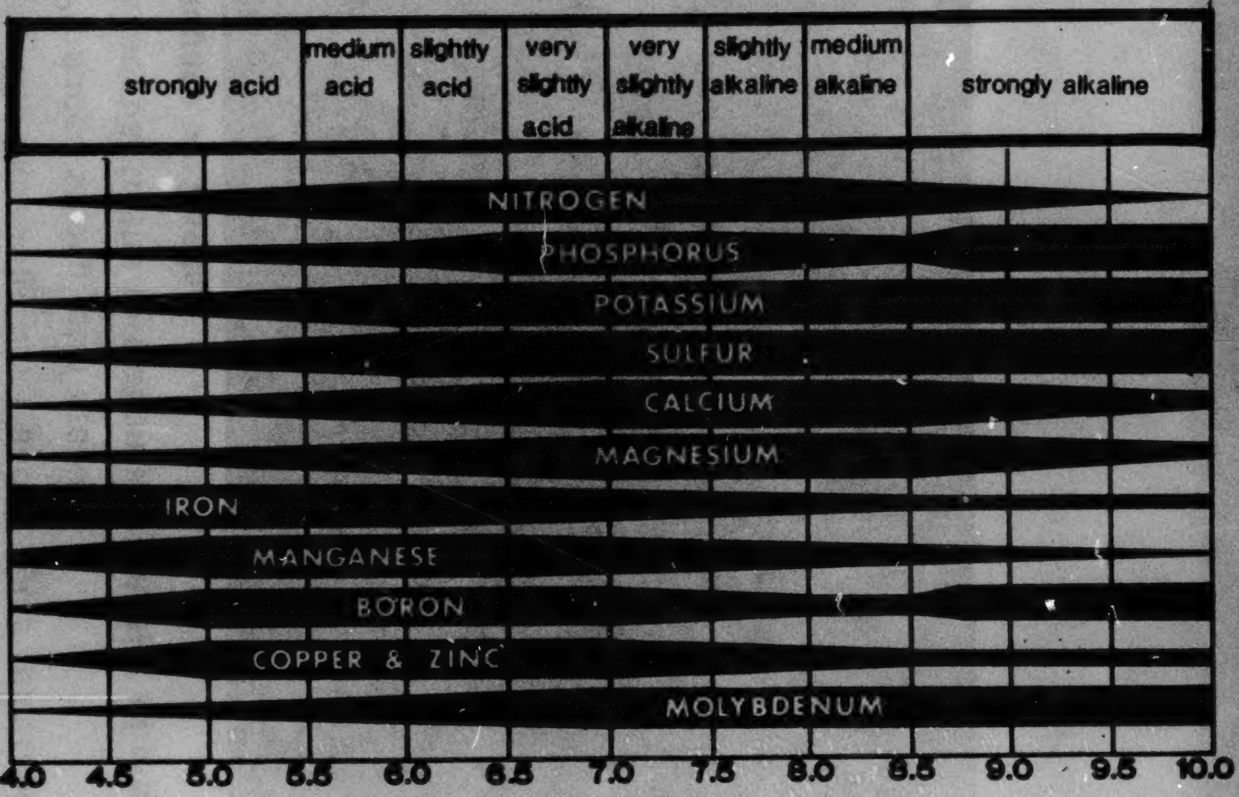
HUNGER SIGNS

1. Scorching or burning of outer edges or tips of lower leaves.
2. Premature loss of leaves.

MOVEMENT IN SOIL

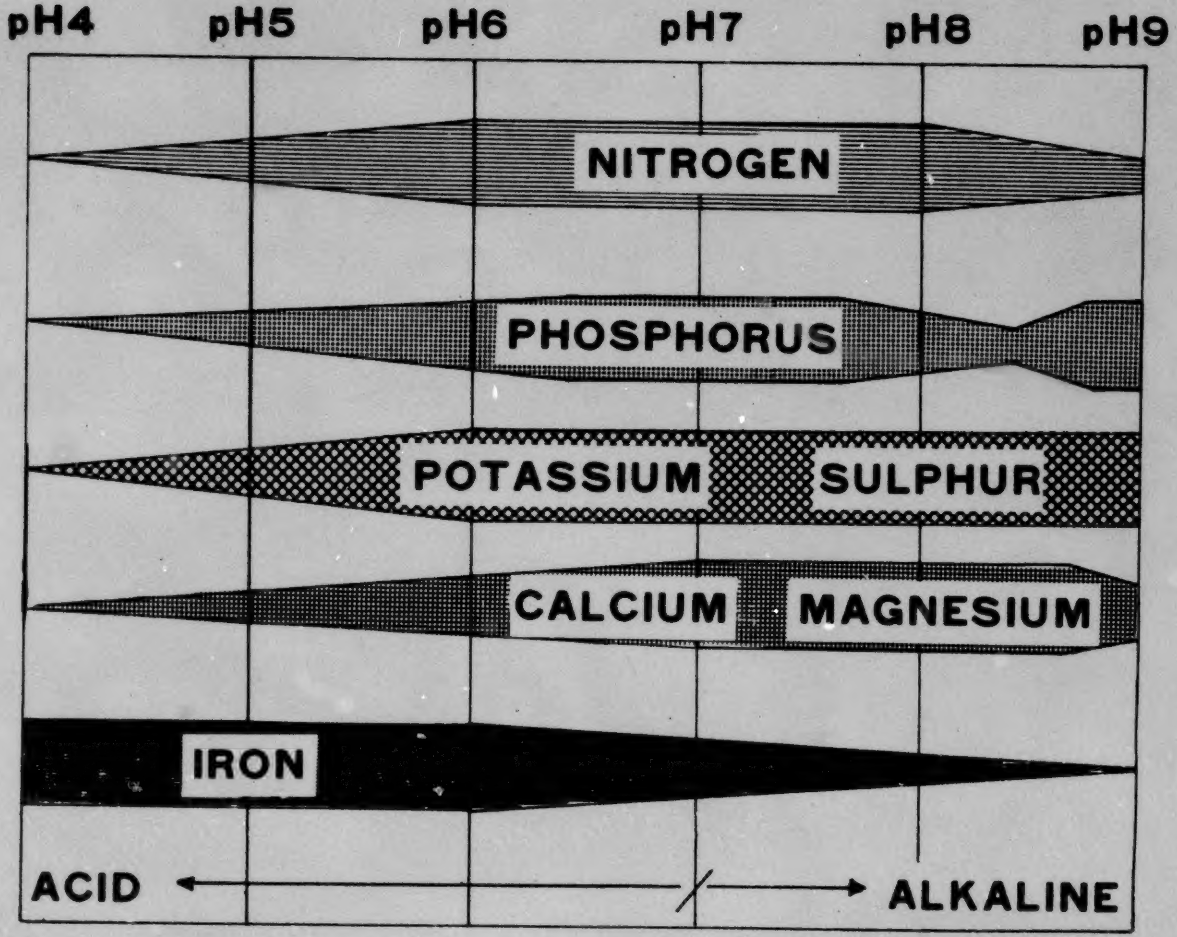
Potassium will move very little in heavy-textured clays and clay loams. It will move with soil moisture in lighter-textured sands and sandy loams.

THE EFFECT OF pH ON PLANT NUTRIENTS



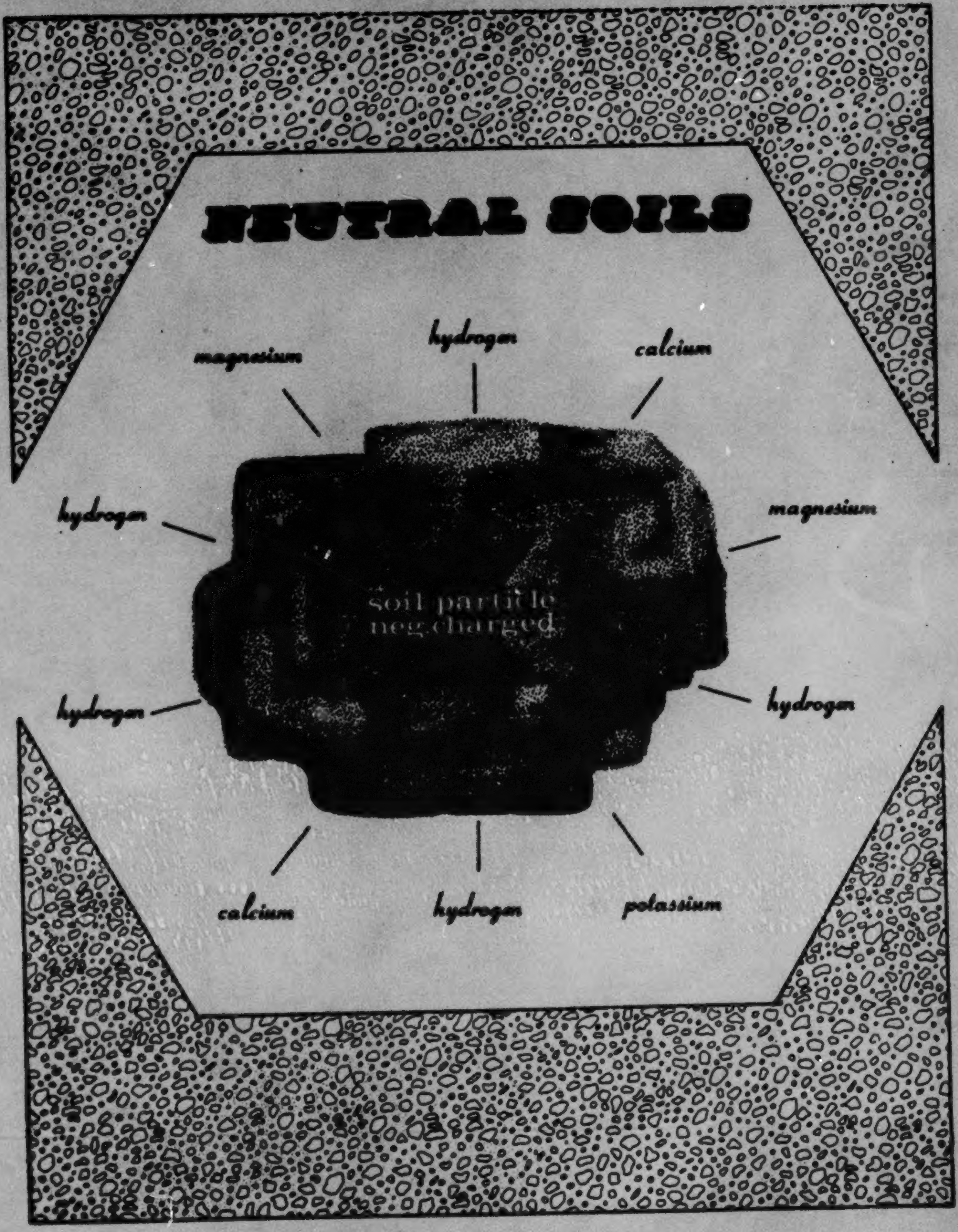
note: availability of nutrients to plants decreases as width of line decreases

SOIL pH and PLANT NUTRIENTS

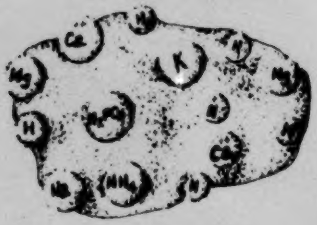


Availability of plant nutrients to plants increases as the width of the bar increases.

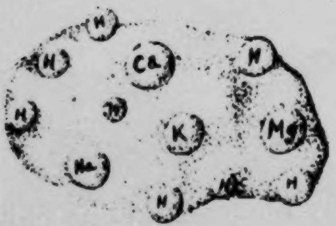
M-II-J-1-49


NEUTRAL SOILS
magnesium
hydrogen
calcium
hydrogen
magnesium
soil particle
neg. charged
hydrogen
hydrogen
calcium
hydrogen
potassium

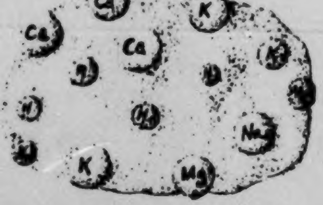
ACID AND ALKALINE SOILS


Ca
H
Mg
K
H
H
NH4
Ca
Na
NH4
H

The nutrients held on the surface of a soil particle are absorbed.


H
H
Ca
H
H
K
Mg
Na
H
H

A soil particle with mostly hydrogen ions tests acid.


Ca
K
Ca
Ca
K
H
K
Na
K
Mg

A soil particle with mostly basic ions tests alkaline

METHODS AND TIMING OF FERTILIZER APPLICATION

	BROADCAST	DRILL	BANDING	SIDEDRESS	WATER	FOLIAR
HOW	Air or ground rig	← Subsurface Placement →			Dry dissolved or liquid injected in irrigation system	Liquid Spray
WHERE	Surface	Subsurface	Subsurface or surface	Subsurface or surface (in furrow)	Furrow or sprinkler	Foliage surface
	← Near root zone--avoid injury →					
	← P and K early in plant growth season →					
WHEN	Preplant and post-plant	Preplant, plant and post-plant	Preplant or at planting	Post-plant	Post-plant	Post-plant
FORM	← Liquid or dry →					Liquid
WHY	Fast Economical	← more efficient → ← Places fertilizer where needed → Nitrogen is confined in root zone ← Longer →			Quick	Quick Efficient with certain elements (i.e. Zn and Fe)

P and K should be drilled, banded and side dressed rather than broadcast whenever possible for maximum efficiency.

SAMPLE PROBLEM

HOW MUCH 12-12-12 FERTILIZER IS REQUIRED TO PROVIDE 2 LBS. OF NITROGEN PER 100 SQUARE FEET OF TURF?

SOLUTION:

1. DETERMINE THE % OF NITROGEN IN A 12-12-12 FERTILIZER
2. DIVIDE THE AMOUNT OF NITROGEN NEEDED BY THE PERCENTAGE OF NITROGEN IN THE FERTILIZER

$$\begin{array}{r} 16.6 \\ .12\,\overline{)\,2000} \\ \underline{12} \\ 80 \\ \underline{72} \\ 80 \\ \underline{72} \end{array}$$

ANSWER:

16.6 POUNDS OF 12-12-12 PER 1000 SQ. FT.

TRANSPARENCY DISCUSSION GUIDE

FERTILIZERS

I. Transparency - ESSENTIAL ELEMENTS

All crops need a number of plant-food elements. There are about 92 chemical elements known to exist in the earth's crust and about 2,000 minerals. Some of the most common elements are oxygen 47.3%, silicon 27.7%, aluminum 7.8%, iron 4.5%, calcium 3.5%, sodium 2.5%, potassium 2.5%, magnesium 2.2% titanium 0.5%, potassium 2.5%, magnesium 2.2% titanium 0.5%, hydrogen 0.2%, carbon 0.2%, phosphorus 0.1%, sulfur 0.1%, and others 0.8%. However, only about 16 of these are currently considered as essential for plant growth. Carbon, hydrogen, and oxygen, which comprise 90 percent or more of the dry matter, are obtained from air and water. The remaining 13 elements are obtained mainly from the soil. Nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur are required in rather large quantities and are referred to as macronutrients or major elements. Nutrients required in considerably smaller quantities are called micronutrients, minor, or trace elements. These include iron, boron, manganese, zinc, copper, molybdenum, and chlorine.

II. Transparency - PROFITS CAN FALL IF ANY NUTRIENT IS SHORT

An inadequate supply of any one of the elements will hinder plant growth or may even stop its potential top yield level. Nutrients must be "in balance". This can be checked by taking representative soil samples, having them tested, and then by applying recommended fertilizers.

A. Discuss the importance of a balanced fertility program.

B. Identify the essential elements for plant growth and the chemical symbols for each.

C. Discuss the differences between Primary, Secondary, and Micronutrients.

III. Transparencies - NUTRIENTS IN FERTILIZERS, PLANT NUTRIENT BLENDS, AND INFORMATION COMMONLY FOUND ON A FERTILIZER BAG

A. Point out the primary information which must be printed on a fertilizer bag.

B. Display examples of fertilizer bags and have students look for this information.

C. Point out the major nutrients contained in fertilizer.

IV. Transparencies - FERTILIZER ANALYSIS, NITROGEN, PHOSPHORUS, AND POTASSIUM

A. Point out the nutrients each number represents on a fertilizer analysis.

B. Discuss the chemical form each nutrient is in.

C. Calculate the total amount of fertilizer in a 100 pound bag when given different analysis.

D. Point out that these three elements are contained in a complete fertilizer.

E. Briefly discuss the functions, hunger signs, and movement in soil for each nutrient.

V. Transparencies - THE EFFECT OF pH ON PLANT NUTRIENTS, AND SOIL pH AND PLANT NUTRIENTS

These transparencies illustrate nutrient availability as influenced by pH. As with width of the nutrient line decreases, the availability of the nutrient decreases. Note how potassium is practically non-available at pH 4.5, but is little affected from pH 7-10. Notice how pH affects the availability of nitrogen, phosphorus, iron, and zinc in the soil pH range of 5-8.5. Acidic conditions limit or decrease the availability of nitrogen and phosphorus. Iron and zinc are little affected under slightly acidic conditions. However, notice the decreased availability of iron and zinc in the alkaline pH range of 7-8.5.

A. Define pH.

B. Discuss the importance of proper soil pH.

C. Identify the pH levels which are desirable for common crops.

D. Point out which materials are commonly used to raise soil pH levels, and to lower soil pH levels.

VI. Transparency - NEUTRAL SOILS

In a neutral pH 7 soil, the negative charges of the soil particles attract both hydrogen and basic ions (examples of basic ions would be calcium, magnesium, potassium, etc.).

There is about a 1 to 1 ratio of hydrogen ions to basic ions; or stated another way, half of the ions attached to the soil particle are hydrogen, and the other half are calcium, magnesium, etc. This is the situation in a neutral soil.

VII. Transparency - ACID AND ALKALINE SOILS

The most important single chemical characteristic of a soil is the degree of acidity or alkalinity. This is referred to as soil reaction. The soil reaction is indicated on a pH scale. The pH scale is divided into 14 equal parts similar to a rule or a thermometer (0-14). The exact center, 7, is the neutral point. Soils with a pH value from 7-14 indicate alkaline soils. The pH values from 0-7 indicate acid soils.

The top diagram shows a soil particle that is near neutral (acid forming elements and alkalinity forming elements are about equal) or a pH of about 7.

The middle diagram shows an acid soil particle (the acid forming elements are in greater number than the alkalinity or basic forming elements) or a pH of about 4.5 (acid).

The lower diagram shows an alkaline soil particle (basic elements outnumer the acid elements) or a pH of about 7.5 (alkaline).

VIII. Transparency - METHODS AND TIMING OF FERTILIZER APPLICATION

Discuss the how, where, when, why and the form of fertilizer used for the various methods of fertilizer application.

IX. Transparency - SAMPLE PROBLEM

A. Use this transparency to help explain and demonstrate how to calculate actual nutrient content of different forms of fertilizer.

B. Provide other examples for students to work to calculate nutrient content.

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

FERTILIZING HORTICULTURAL CROPS

True (T) - False (F)

T 1. Phosphorus stimulates root formation.

T 2. Phosphorus stimulates blooming?

F 3. Phosphorus slows maturity.

T 4. A deficiency of nitrogen produces a pale yellow green color in leaves.

F 5. Nitrogen induces slow growth.

T 6. Lack of potassium encourages leaf scorch.

F 7. Potassium reduces disease resistance in plants.

F 8. Fertilizers are necessary only in sunny climates.

T 9. Harvesting removes nutrients from the soil.

T 10. A complete fertilizer contains (NPK).

T 11. Hydrated lime reacts very quickly and is more expensive than agricultural lime.

F 12. A ratio is the proportion of the three elements (NPK) one to another. 10-20-10 is 1-3-1.

F 13. Purple coloring of young plants indicates a deficiency of potassium.

F 14. Boron is a major plant nutrient.

F 15. An acid soil is the same as an alkaline soil.

T 16. A soil wth a pH of 6.2 is acid.

F 17. Micronutrients are not essential to plant growth.

T 18. The nitrogen in organic matter is not in an available form for plant use.

T 19. Ammonium nitrogen will not quickly change to nitrate nitrogen when the soil temperature is below 50°F.

T 20. Plants use most of their nitrogen in the nitrate form.

F 21. Copper is a secondary plant nutrient.

F 22. Acid soils are bad for all crops.

F 23. Lime should be applied every year.

Completion

1. The best way to keep check on soil acidity levels is by soil testing.

2. The most desirable pH range for horticultural crops is between 6.0 and 6.5.

3. A soil with a pH level below 7.0 would be considered acid, above 7.0 would be considered basic, and exactly 7.0 would be considered neutral.

4. Lime is composed of calcium carbonate.

5. Dolomitic limestone is composed of calcium and magnesium.

6. A high concentration of H^+ ions is termed acidity.

7. Two major plant nutrients which become limited as acidity increases are phosphorus and potassium.

8. The element that corrects soil acidity is calcium.

9. Nutrients which are used only in trace amounts are called micronutrients.

10. The number 10-6-4 on a fertilizer package stands for 10% nitrogen, 6% P_2O_5 and 4% K_2O.

11. The test that measures soil acidity is pH.

12. The form of phosphorus which is available to plants is H_2PO_4.

13. P_2O_5 is 44% actual phosphorus.

14. K_2O is 83% actual potassium.

Matching

1. Match the nutrients on the right to the correct deficiency symptoms.

3 a. Stunted growth, pale green foliage, oldest leaves turn yellow and defoliate. Some crops show reddish color instead of pale green.

1 b. Slender stems, shoots, or roots; green leaves with marginal browning of leaves which can extend into the leaves, forward curling of leaves.

4 c. Dwarfed plants; thin shoots or stems small leaves, dull purplish color of whole plant, early defoliation.

2 d. Interveinal chlorosis (yellow first, then brown) of oldest leaves, leaf margins at the beginning green, later on yellow, withering of old leaves.

1. Potassium
2. Magnesium
3. Nitrogen
4. Phosphorus

2. Match the major (primary) plant nutrients on the right to the correct characteristics.

3 a. Is part of every living cell; gives dark green color to chlorophyl molecule; aids and promotes seed development; increases protein and yields; promotes rapid growth; is easily translocated.

2 b. Is part of every living cell; contributes to early maturing crops; is necessary for seed formation; stimulates root growth; is easily translocated.

1 c. Is necessary for production and translocation of carbohydrates; produces plumper seed; controls water intake and respiration; promotes health and vigor of plants; stiffens straw and stalks; is easily translocated.

1. Potassium
2. Phosphorus
3. Nitrogen

Essay and Short Answer

1. Describe four methods of fertilizing a tree in the home landscape.
   a. Foliar application
   b. Broadcast application
   c. Direct application to the root zone
   d. Capsules placed in the trunk

2. Describe the common mistakes made with a drop spread in fertilizing a lawn.
   a. Incorrectly calibrated allowing too much or too little fertilizer to be applied
   b. Missed spots in the lawn creating a striped look

3. Identify five organic fertilizers.
   a. Manure
   b. Bone meal
   c. Sludge
   d. Dried blood
   e. Wood ashes

4. List one source used to raise soil pH.

   Pulverized limestone

5. List one source used to lower soil pH.

   Powdered sulfur

6. List three advantages of organic fertilizers
   a. Slow release
   b. Low analysis
   c. Adds to organic matter in the soil

7. List three advantages of inorganic fertilizer.
   a. Quick release
   b. Higher concentrations
   c. May add only one nutrient

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Multiple Choice

B 1. A soil with a pH of 7.5 is:

a. acid
b. alkaline
c. sour
d. neutral

C 2. The percent of nitrogen in urea is:

a. 20
b. 33
c. 45
d. 82

B 3. Which of the following is not a potassium fertilizer?

a. Muriate of potash
b. Nutrate of soda
c. 0-0-60
d. KCl

B 4. Which of the following is a nitrogen fertilizer?

a. 0-20-0
b. 20-0-0
c. 0-0-20
d 0-82-0

C 5. How much phosphorus is in a 50 pound bag of ammonium phosphate (16-20-0)?

a. 20
b. 10
c. 4.4
d. 8.8

A 6. How much nitrogen is in a 50 pound bag of ammonium sulfate (20-0-0)?

a. 10
b. 20
c. 100
d. 8.8

A 7. How much K_2O is in a 100 pound bag of potassium nitrate (12-0-40)?

a. 40
b. 20
c. 33.2
d. 16.6

UNIT K: Agricultural Products

PROBLEM AREAS:

1. Identifying and selecting fresh fruits and vegetables
2. Identifying and selecting ornamental horticultural products

UNIT K: AGRICULTURE PRODUCTS

PROBLEM AREA: IDENTIFYING AND SELECTING FRESH FRUITS AND VEGETABLES

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with second-year students in a horticultural program. The recommended time for teaching this problem area is during the winter months when outdoor activities aren't possible.

The estimated instructional time for this problem area is 3 to 5 days, depending on how far the teacher wishes to go in developing fresh fruit and vegetable identification and selection skills at the second-year level. If the teaching plan is limited to classroom discussion, with little or no practice or observation, the instruction can be 3 days or less. If the students are to be involved in other activities or exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as the instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, student worksheet, and test questions were developed by Jim Ethridge, Horticulture Instructor, Joliet Junior College, Toni Farrell, Horticulture Teacher, Zion-Benton High School, and Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Field Test Teachers.

TEACHER'S GUIDE

I. Unit: Agriculture products

II. Problem area: Identifying and selecting fresh fruits and vegetables

III. Objectives: At the close of this problem area, the student will be able to --

1. Evaluate fresh fruits and vegetables, as desired by the consumer, using established procedures.

2. Identify commonly found fresh fruits and vegetables in a retail situation.

3. Distinguish diseased from non-diseased fresh fruits and vegetables.

4. Identify common diseases and insect damage found on retail fresh fruits and vegetables.

5. Describe fruits and vegetables by their size, shape, and color.

6. Select and prepare fresh fruits and vegetables for exhibition.

IV. Suggested interest approaches:

1. Obtain fruits and vegetables, including as many unusual ones as possible, and ask students to name them.

2. Obtain a few tropical and/or unusual fruits. Blindfold a few volunteer students and have them identify the fruit by taste.

3. Ask students to quickly list as many fresh fruits and vegetables as possible from memory that are found in a grocery store.

4. Ask students about having bought diseased or lead-tasting fresh fruits or vegetables; have them relate their experiences.

5. Ask students to estimate the number of fresh fruits and vegetables in the average grocery store.

6. Ask students what their favorite fruit is, then ask what are its common diseases and where the fruit is grown.

7. Carry a tray of fresh fruit and/or vegetables around the room allowing each student to study the contents for about 10 seconds. Ask them to list all of the fresh fruits and/or vegetables they saw.

V. Anticipated problems and concerns of students:

1. Why is it important to know the names of fresh fruits and vegetables?

2. How can one tell the difference between fresh fruit and vegetable qualities?

3. What are the fresh fruits and vegetables commonly retailed in Illinois?

4. What is a fruit?

5. What is a vegetable?

6. How are fresh fruits and vegetables best kept fresh?

7. How can one tell the top from the bottom of a fruit?

8. What are the different parts of a fruit?

9. What are the different parts of a vegetable?

10. What are common disease problems in the grocery store?

11. What do the common diseases on fresh fruits and vegetables look like?

12. How important are fresh fruits and vegetables in the diet?

13. What should a non-diseased fresh fruit or vegetable look like?

14. How can you tell when a fruit or vegetable is ripe?

15. What fruits and vegetables can one eat raw?

16. Why is it economical to buy fruit in season?

17. What are some common myths about fresh fruits and vegetables? (Example: Carrots help your eyesight, carrots turn your skin orange, garlic wards off vampires.)

18. What is grading and why is it important?

19. Does fruit for exhibition have to be ripe?

20. Should I always exhibit my biggest fruit and vegetables?

21. Am I allowed to exhibit "Better Boy" tomatoes as a different vegetable than "Early Girl" tomatoes?

22. How important is the arrangement of vegetables for exhibition?

23. How should lettuce be exhibited?

VI. Suggested learning activities and experiences:

1. Begin the instructional phase of this problem area with the following steps:

   a. Conduct an interest approach.
   b. Assist students in the identification of goals and objectives.
   c. Have students identify their problems and concerns about identification and selection of fresh fruits and vegetables.

2. Have students answer problems and concerns through class discussion and from information supplied by the teacher. Use the instructional aids listed in the references and aids section of this problem area.

3. Have the students complete the worksheet "Evaluating Fruits and Vegetables."

4. Have horticulture students conduct a display show for other students. Make each student (or pair of students) responsible for one fruit and/or one vegetable, its proper display and the reasoning behind the placement. (Use the Information Sheet "Selecting Vegetables for Exhibition.")

5. Have the students give demonstrations showing how to prepare fresh fruits and vegetables, either for immediate consumption or for canning and freezing.

6. Organize a field trip to a grocery store or wholesaler and observe produce workers unpacking fresh fruits and vegetables and displaying them in sales areas. Identify fruits and vegetables during this process.

7. Have the students complete the Worksheet "Produce Information and Grading."

8. Set up a judging contest with readily available fruits and vegetables. Hold a class discussion on the evaluation of fresh fruits and vegetables by having students give oral reasons for their placings.

9. Have students participate in chapter, sectional or state fruit and vegetable judging contests.

10. Have students individually (or in groups) do reports on grading of a specific group (or individual) fruit or vegetable type.

11. Discuss grade standards with the students. Contact a local wholesaler or grocery store for further information on how fruits and vegetables are graded.

VII. Application procedures:

1. After class members have solved their problems and concerns, answered the basic questions and become familiar with the process and need for grading and evaluating vegetable and fruit produce, exercises can be used to provide students with practice in selecting and critically evaluating certain agriculture products.

2. If sectional and state contests are to be used as an instructional aid, then the time to teach this problem area would need to be taught prior to scheduled contest dates.

3. At the close of the problem area, the class member should be able to write or prepare a speech on the purchasing of various grades of agricultural products as related to their uses and price.

4. The teacher shall acquire as many fruits and vegetables as possible to use in the identification exercise. The teacher should visit a local grocery store and obtain specimens of rotted fresh fruit and vegetables for student inspection and identification of fruit and vegetable diseases.

VIII. Evaluation:

1. Administer and evaluate worksheets provided in this problem area.

2. Score students' placings of various rings of vegetables and fruits.

3. Evaluate the students' reports on the purchasing of agriculture products when considering use, grade and prices.

4. Administer a written test upon completion of this problem area.

IX. References and aids:

1. West Virginia University Cooperative Extension Service, Appalachian Center, Morgantown, WV 26506. Special Circular 445, "Horticulture Identification Handbook."

2. University of Illinois, College of Agriculture Cooperative Extension Service

   a. Circular C935, "Growing Small Fruits in the Home Garden."
   b. Circular 1013, "Growing Tree Fruits in the Home Orchard."

3. University of Illinois, Vocational Agriculture Service Slidefilm 1108-2.3, "Diseases of the Vegetable Garden."

4. North Central Regional Extension Publications No. 45, "Diseases of Tree Fruits."

5. Horticulture Science, Second Edition, Janick, Jules, Purdue University, 1972. W. H. Freeman and Company, San Francisco.

6. Fruit and Vegetable Facts and Pointers, United Fresh Fruit and Vegetable Association, 777 14th Street, N.W., Washington, DC 20005.

7. Information Sheets included in this problem area:

   a. "Selecting Vegetables for Exhibition"
   b. "Exhibiting Don'ts"
   c. "General Considerations in Selecting Vegetables for Consumption or Exhibition"
   d. "Selection Scorecard"
   e. "Suggested Fruits and Vegetables for Identification"

8. Vegetable Identification Slide Kit, Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California, 93407.

INFORMATION SHEET

SELECTING VEGETABLES FOR EXHIBITION

The purpose of this sheet is to assist people in identifying quality garden vegetables and preparing garden vegetable exhibits.

EXHIBITING INFORMATION

It is difficult for many people to exhibit an attractive box of vegetables without using "filler" materials. In some cases, the bottom of the box cannot even be covered with vegetables without using "filler" materials or several specimens of large vegetables.

It is difficult for many people to exhibit a box of vegetables of good market quality at either the county fair or state show since many of their vegetables are either not in good condition or have been used up before fair time.

The exhibit requirements for an advanced gardener (one box of at least eight but not more than twelve kinds of vegetables) should be interpreted as follows: tomatoes are to be counted as one kind of vegetable even though red, yellow, green, and cherry tomatoes are included in the same box. The same is true of beans, cucumbers, onions, peppers, lettuce, and all other vegetables except summer and winter squash, which will be considered as two different kinds of vegetables.

Gourds, herbs, peanuts, Indian corn, oddities and ornamentals should not be included in vegetable exhibits.

It is recommended that not more than one kind of large vegetable be exhibited in a box because of the difficulty involved in arranging an attractive display when more than one kind is included. "Filler" materials should not be used.

SPECIFIC CONSIDERATIONS

Vegetable	No. for Exhibit	Selection and Preparation Pointers
Artichokes, Globe	3	Select heads 3 to 4 inches in diameter which are globular, bluntly cone-shaped, and deep green.
Beans, Green or Wax	12 pods	Select long, straight, well-filled pods of the same length and color. Pods should be clean, firm, crisp, and free from strings and blemishes. Seeds should be no larger than half size. Leave stems attached and tie pods in a bunch.
Beans, Lima	12 pods	Select well-filled, clean, bright, dark green pods.
Beets	5	Select roots free of side roots, cracks, and blemishes and remove the tops ½ to 1 inch above the crown. Clean the roots by placing them in cold water and then carefully wiping off the soil. Desirable size is approximately 1½ to 3 inches in diameter. Tap roots should not be removed.
Broccoli	1 bunch (approx. 1 pound)	Select a central crown or side shoots that are compact, evenly colored, and without yellow flowers. Leave a few leaves surrounding the head but trim the leaf tips to one inch above the head.
Brussels Sprouts	12	Sprouts should be uniform, medium in size, firm, well-shaped, compact, and green in color. Trim the stem to ½ inch.
Cabbage	1	Select a solid, firm, fresh, crisp head. Trim off all but 2 or 3 of the outer leaves. Cut the stem ¼ to ½ inch below the lowest leaf.
Cantaloupe	1	Select a well-netted specimen which is fairly mature and of market quality.

Carrots	5	Select smooth, straight, firm, bright colored specimens 1 to 1½ inches in diameter and remove the tops ½ to 1 inch above the crown. Do not remove the tap root and avoid specimens that are greenish or pale yellow in color.
Cauliflower	1	Select a white, smooth, solid head. Leave a few leaves surrounding the head, but trim the leaves to 1 inch above the head. Trim the stem to ½ inch below the bottom leaf.
Celery	1 plant	Select a large plant with many crisp stalks. Remove the small outside stalks or suckers and trim the stem neatly. The leaves may be partially clipped.
Corn, Sweet	5	Select well-filled ears with kernels in the milk stage. Husks should be fresh and green and should fit tightly around the ear. Leave the husks on and don't cut any windows in the husks.
Cucumbers, Pickling & Slicing	5	Select straight, well-shaped, green specimens with a minimum of white or yellow streaks. Cut the stem off. Length: less than 3 inches long for small pickles, between 4 and 5½ inches for dills, and not over 8 inches for slicing.
Eggplant	1	Select a solid, medium-sized specimen which is deep purple and nearly black in color and without bronzing and green or white streaks. Clean with a damp soft cloth. Leave a stem 1 to 1½ inches long.
Kohlrabi	5	Select specimens which are solid, crisp, of medium size (3½ to 4 inches in diameter), well-shaped, and tender (puncturable with thumbnail). The roots should be cut off just below the ball and 4 to 6 leaves should be allowed to remain but should be trimmed to ½ inch from the ball.

Leeks	5	Select specimens which are long, thick, firm, and with pure white, well-blanched stems. The tops should be shortened, the roots removed, and the stems tied neatly.
Okra	5 pods	Select pods that are nearly straight, not twisted or curved. Pods should be harvested before they become woody and fibrous and before the seeds harden. At this stage, the pods snap easily when bent and are easily punctured.
Onions, Dry	5	Select well-shaped bulbs not less than 2 inches in diameter. Bulbs should be free from sprouts, bruises, and doubles. Harvest bulbs 2 to 3 weeks before showing if possible so that they will be well ripened. Roots should be cut off just below the base of the bulb; only broken and dirty outer scales should be removed and the tops should be cut off ½ to 1 inch above the bulb. Specimens should have bright, clean, dry outer scales.
Onions, Green	1 bunch	Select medium-sized specimens having long, straight, white shanks and remove the wrapper skins just before showing. Do not remove the roots and tops. Tie about 10 in a bunch.
Parsnips	5	Select firm specimens having a long, even taper and no side roots. The skin should be smooth, light creamy colored, and free of discoloration. Tops should be cut off ½ inch above the crown. Soil should be soaked off with water to avoid rubbing the skin and all side rootlets trimmed off. Tap root should be left on.
Peas	12 pods	Select well-filled, firm pods which are not overmature (before the pods begin to shrivel and dry). Pods should be picked carefully and handled as little as possible to avoid removing the bloom. Pick and exhibit them with the stems on.

Peppers	5	Select specimens with the same number of lobes (points). Peppers should be of uniform color, firm, and have thick flesh. Clean by wiping with a damp cloth and leave stems attached.
Potatoes	5	Select medium-sized tubers (6 to 10 oz.) which are well shaped and uniform. Harvest a few days ahead of showing and clean by brushing lightly or washing.
Pumpkin, Pie	1	Select a well-matured specimen about 7 inches in diameter and leave the stem attached. The specimen should be smooth, heavy, well shaped, firm, and reddish orange in color. Clean by washing.
Radishes	5	Select smooth, firm, medium-sized, specimens and remove the tops ½ to 1 inch above the crown. Wash thoroughly. Trim the main root if it is very long.
Rutebagas	3	Select smooth specimens 3½ to 5 inches in diameter and remove the tops ½ to 1 inch above the crown. Trim the main root if it is very long.
Salsify	5	Select specimens which are as straight and smooth as possible and at least 6 inches long and 1 to 1½ inches in diameter at the top. Specimens should not be soft, flabby or shrivelled. Remove tops ½ to 1 inch above the crown. Remove rootlets and side roots and trim the main root if it is very long.
Squash, Summer	3	Select immature specimens and leave stem attached. Pick 3 or 4 days after the flower opens and cut off from vine. The rind should be soft (easily punctured with thumbnail). Use soft cloth to remove soil. Specimens of the Crookneck and Straightneck varieties should be picked when about 5 to 6 inches long for highest quality.
Squash, Winter	1	Select a mature specimen and leave the stem attached. The skin should be very hard (not puncturable with thumbnail).

Sweet Potatoes	5	Select well-shaped specimens. Specimens should be dug at least a few days in advance of showing to allow some curing. Clean by brushing lightly or washing. A short stem and about 1 inch of the tap root should be left attached.
Tomatoes, Green, Pink, or Ripe	5	Select firm specimens that are evenly colored, and free of cracks, spots, sunscald, and blemishes. Remove stems on pink and ripe specimens to avoid injury to adjacent specimens. Stems may be left on green tomatoes.
Turnips	5	Select sooth, medium-sized specimens about 1 3/4 to 2 3/4 inches in diameter. Rootlets should be removed but leave 2 to 3 inches of the tap root remaining. Remove the tops ½ to 1 inch above the crown.
Watermelon, Ice Box Type	1	Select a specimen that is of market quality and trim the stem to 1 inch.

LEAFY VEGETABLES

Since leafy vegetables do not hold up well, they are not recommended for exhibiting. If it is necessary to include them in an exhibit, the following suggestions should be followed. Hold them in plastic bags until just prior to exhibiting.

Vegetable	No. for Exhibit	Selection and Preparation Pointers
Chinese Cabbage	1 head	Select a compact head and cut the stem off ¼ inch below the lower leaves and remove the outer discolored leaves.
Collards	1 plant	Cut the plant with a large knife, leaving 4 to 5 wrap leaves to protect the plant. Remove all dead or damaged leaves.
Endive	1 plant	Select a stout, crisp, tender specimen with a well-blanched heart. The roots should be removed.
Kale	1 plant	Select a specimen with foliage that is heavy, large, dark green, closely set, and well curled. Cut the plant off at the crown of the root.
Lettuce, Head	1 head	Select a medium-sized, firm head which is fresh and crisp. Coarse or damaged outer leaves should be removed, and cut the stem off close to the bottom leaf. Wash if necessary.
Lettuce, Leaf	1 plant	Select a reasonably compact plant having crisp, tender, medium green leaves. The entire plant should be cut just above the crown and discolored or injured leaves removed. Clean by washing.
Mustard	1 plant	Cut entire plant just below crown. Remove discolored or injured leaves and wash thoroughly.
New Zealand Spinach	1 plant	Cut entire plant just below crown. Remove discolored or injured leaves and wash thoroughly.

Parsley	1 bunch	Leaves should be fresh and tender and may be cleaned by washing. About 20 sprigs make a good bunch. Trim stems evenly and make the bunch 8 to 10 inches in overall length.
Spinach	1 bunch	Leaves should be large, broad, thick, and fresh.
Swiss Chard	1 bunch	Leaves should be fully expanded, large, broad, and crisp with bright, tender, fleshy leaf stalks. Clean by washing if necessary. Ten leaves make a good bunch.

INFORMATION SHEET

EXHIBITING DON'TS

1. Don't show specimens of vegetables that are injured or dirty.
2. Don't show vegetables that are not uniform in size, shape, color, maturity and type.
3. Don't exhibit overmature vegetables.
4. Don't exhibit more than one kind of large vegetable in a box, if possible.
5. Don't exhibit leafy vegetables unless it is absolutely necessary.
6. Don't use filler material.
7. Don't peel onions. Harvest the bulbs 2 to 3 weeks before showing so that they will be well ripened and so the dirty outer scales will be dry and easily removed and peeling will not be necessary.
8. Don't cut windows in the husks of sweet corn.
9. Don't exhibit mature summer squash.
10. Don't exhibit the biggest vegetables that you have because unusual size frequently indicates poor quality due to over maturity.
11. Don't include gourds, herbs, peanuts, Indian corn, oddities and ornamentals in vegetable exhibits.
12. Don't exhibit specimens of Turks Turbin, which is a gourd.
13. Don't count different varieties of one vegetable as different kinds of vegetables.
14. Don't forget to arrange an attractive display with your vegetables.

INFORMATION SHEET

GENERAL CONSIDERATIONS IN SELECTING VEGETABLES FOR CONSUMPTION OR EXHIBITION

FREEDOM FROM INJURY

All vegetables should be completely free of insect, disease, mechanical and weather injuries.

GROWTH QUALITY

Growth quality is determined mainly by appearance and includes maturity, marketable size, freedom from roughness, and trueness-to-type.

Maturity. Vegetables should be in prime condition for eating at the time of judging.

Marketable Size. The biggest usually is not the best and, for many vegetables, unusual size frequently indicates poor quality which may be due to over maturity.

Freedom from Roughness. Vegetables should be free from excessive roughness such as that caused by crowding in the row.

Trueness-to-Type. All vegetables should be as true to the variety or type as it is possible to grow and select them.

CONDITION

The condition of exhibits is very important and includes freshness, cleanliness, and trimming.

Freshness. Vegetables should be harvested and prepared as close to the exhibition date as possible and care should be taken to prevent wilting and shrivelling.

Cleanliness. Vegetables should not show any signs of soil or other material which causes unsightliness. Vegetables are usually cleaned by the following methods: brushing with a soft brush, wiping with a damp cloth, and washing.

Trimming. Vegetables should be neatly and properly trimmed.

UNIFORMITY

Vegetables should be uniform in size, shape, color, maturity, and type.

Size. Choose the size that is desirable on the market. Remember that the biggest is usually not the best and, for many vegetables, unusual size frequently indicates poor quality.

Shape. Select the typical shape for which the variety is noted.

Color. Should be uniform for all specimens of a variety and the more intense or deeper-colored specimen is usually preferred.

Maturity. Specimens should be of like maturity.

Type. Vegetables should be true-to-type and uniform in type.

INFORMATION SHEET

SELECTION SCORECARD

Name: ____________________

Address: ____________________

County: ______________ Section: ________ Class: ________

For Beginner, Junior and Commercial Garden Projects

Vegetable:

Freedom from Injury:

Insects
Disease
Mechanical
Weather

Growth Quality:

Maturity
Marketable Size
Freedom from Roughness
Trueness to Type

Condition:

Freshness
Cleanliness
Trimming

Uniformity:

Size
Shape
Color
Maturity
Type

Checks (   ) indicate points that should be improved.

Judge's Comments:

For Senior Garden Projects

Kind of Vegetables	Judges Comments

INFORMATION SHEET

SUGGESTED FRUITS AND VEGETABLES FOR IDENTIFICATION

The following is a list of 25 fruits and 40 vegetables to be identified. The teacher should shorten or lengthen the list according to season and amount of time to be spent on this problem area.

Fruits

1. Apple, Red Delicious
2. Apple, Golden Delicious
3. Apple, Jonathon
4. Avocado
5. Blackberry
6. Blueberry
7. Cherry
8. Cranberry
9. Elderberry
10. Gooseberry
11. Grape, Concord
12. Grape, Thompson
13. Grapefruit
14. Lemon
15. Lime
16. Nectarine
17. Orange
18. Papaya
19. Peach
20. Pear
21. Pineapple
22. Plum
23. Raspberry
24. Strawberry
25. Tangerine

Vegetables

1. Asparagus
2. Beans, Lima
3. Beans, Snap
4. Beet, Garden
5. Broccoli
6. Brussel Sprouts
7. Cabbage, Green
8. Cabbage, Red
9. Cauliflower
10. Celery
11. Collards
12. Cucumber
13. Eggplant
14. Endive
15. Horseradish
16. Jerusalem Artichoke
17. Kale
18. Lettuce
19. Mushroom
20. Mustard
21. Melon, Cantaloupe
22. Melon, Honeydew
23. Melon, Watermelon
24. Onion
25. Parsley
26. Peas
27. Popcorn
28. Pumpkin, Zucchini
29. Pumpkin, Sugar Pie
30. Pepper
31. Potato
32. Radish
33. Rhubarb
34. Spinach
35. Squash, Acorn
36. Squash, Butternut
37. Sweet Corn
38. Sweet Potato
39. Swiss Chard
40. Turnip

WORKSHEET

EVALUATING FRUITS AND VEGETABLES

Using criterion listed in the Information Sheet on Selecting Vegetables for Exhibition, have students judge vegetables provided.

Example:

Evaluation

Vegetables:

Beets, Carrots, Onions, Peppers, Tomatoes

Directions:

The plates are lettered A through D. When you have decided whether a plate is Excellent (Ex.), Good (G), Worthy (W), or Unworthy (U), circle the proper Ex, G, W, or U. There will be a box by each set so that you may give a brief explanation of why you chose the placements you did.

Deductions:

1 place missed equals minus 3 points
2 places missed equals minus 9 points
3 places missed equals minus 15 points
Omissions equal minus 13 points
Duplications equal minus 15 points

Beets						Explanation
Plate	A	EX	G	W	U	____________________
	B	EX	G	W	U	____________________
	C	EX	G	W	U	____________________
	D	EX	G	W	U	____________________

Carrots						
Plate	A	EX	G	W	U	____________________
	B	EX	G	W	U	____________________
	C	EX	G	W	U	____________________
	D	EX	G	W	U	____________________

Onions

Plate A EX G W U ____________________
B EX G W U ____________________
C EX G W U ____________________
D EX G W U ____________________

Peppers

Plate A EX G W U ____________________
B EX G W U ____________________
C EX G W U ____________________
D EX G W U ____________________

WORKSHEET

PRODUCE INFORMATION AND GRADING

1. Common name of fruit or vegetable: ______________________________

2. Scientific name: ________________________ ________________________
   genus species

3. Per capita consumption: ____________________ lbs/year

4. Grade standards:

   a. c.

   b. d.

5. Main trading grade: ______________________________

6. Tolerances: ______________________________

7. Special definitions:

   a.

   b.

   c.

   d.

8. Standard packing:

9. Quality criteria:

10. Varieties:

    a. c.

    b. d.

11. References used:

KEY TO WORKSHEET

PRODUCE INFORMATION AND GRADING

1. Common name of fruit or vegetable: Crisphead Lettuce

2. Scientific name: Lactuca (genus) Sativa (species)

3. Per capita consumption: 21.5 lbs./year

4. Grade standards:

   a. U.S. Fancy
   b. U.S. No. 1
   c. U.S. Commercial
   d. U.S. No. 2

5. Main trading grade: U.S. No. 1

6. Tolerances:

   a. At shipping point 8% for heads of lettuce which fail to meet the requirements of this grade:
      Provided: In this amount, not more than 4% shall be allowed for defects causing serious damage.

   b. Enroute or at destination.

7. Special definitions:

   a. "Fresh" means that the head as a whole has normal succulence and the wrapper leaves are not more than slightly wilted.

   b. "Green"

   c. Overgrown

   d. Injury

8. Standard packing: Heads of lettuce shall be fairly uniform in size and tightly packed in uniform layers in standard fiberboard containers; 2½ doz. pack.

9. Quality criteria:

   Look for signs of freshness in lettuce. For Iceberg lettuce and Romaine, the leaves should be crisp. Other lettuce types will have a softer texture. Avoid: heads of Iceberg type which are very hard and which lack green color.

10. Varieties:

    a. Crisphead
    b. Butterhead
    c. Romaine or Cos
    d. Looseleaf

11. References:

Fruit and Vegetable Facts and Pointers
United Fresh Fruit & Vegetable Association
777 14th Street, N.W.
Washington, D.C. 20005
October, 1970. Third Revision: Lettuce - R. A. Seelig

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SAMPLE TEST QUESTIONS AND TEACHER'S KEY

IDENTIFYING AND SELECTING FRESH FRUITS AND VEGETABLES

Multiple Choice

A 1. Asparagus is a perennial, the edible part of the plant being the ________.

a. shoot
b. leaf
c. berry
d. petiole

B 2. Beets are an enlarged fleshy structure called the ________.

a. leaf
b. root
c. tuber
d. corm

D 3. Broccoli is grown for its thickened ________ that arise from the crown and from the axils of the leaves.

a. tubers
b. leaves
c. stems
d. flower shoots

B 4. The leaves of the ________ form a head which varies in shape from cone to globe.

a. cauliflower
b. cabbage
c. celery
d. asparagus

C 5. Carrots may be eaten ________.

a. raw
b. boiled, then frozen
c. raw or cooked

D 6. The ________ of celery may be eaten either raw or cooked.

a. roots
b. stems
c. berry
d. leaf stalk

C 7. The eggplant is a vegetable that bears _________ fruits on a bush.

- a. black
- b. green
- c. purple
- d. red

A 8. Potato tubers are not part of the roots of the plant, but are formed from underground _________.

- a. stem
- b. leaves
- c. stalks
- d. fruits

B 9. The tomato is a very popular fruit which is used as a vegetable. It turns _________ when ripe.

- a. green
- b. yellow or red
- c. blue
- d. purple

D 10. The grape is a smooth skinned juicy fruit which is sold _________.

- a. by individual fruit
- b. by the pound only
- c. for its roots
- d. in bunches or clusters

C 11. The avocado is grown for its _________.

- a. seed
- b. skin
- c. pulp
- d. leaves

C 12. Pears are used extensively as a _________ fruit.

- a. breakfast
- b. boiling
- c. dessert
- d. dried

A 13. The orange is the most important of all the citrus fruit being used for its _________ or peeled and eaten.

- a. juice
- b. seed
- c. pulp
- d. skin

C 14. The strawberry is a ________ fruit.

a. small green
b. large blue
c. small red
d. medium orange

D 15. Illinois is the number one producer of ________.

a. limes
b. blueberries
c. grapes
d. horseradish

True (T) - False (F)

F 1. The plum is a stone fruit.

T 2. The pineapple is a thickened spine of the plant.

T 3. The peach is second only to the apple in distribution throughout the world.

F 4. The lemon is a green citrus fruit when ripe.

T 5. The radish is an annual plant.

F 6. Watermelon has a thin, leathery outer covering.

T 7. Pepper fruits are green when immature, but change to red when fully ripened.

T 8. Peas are a cool season crop which have almost as much protein as meat.

F 9. Sweet corn is grown chiefly for its stem.

T 10. Cauliflower is made up of tight clusters of flower parts with short fleshy stalks.

Fill in the Blank

1. Scale insects are responsible for blemishing the skin of apples.

2. Peach borers attack the trunk and branches of trees of stone fruits, especially peach trees.

3. Apple scab is caused by a fungus.

4. Fruit infections of apple scab result in cracking of the skin.

5. Size characteristics may be used in grading such as stem length, stem diameter, and weight of the fruit or vegetable.

6. The legislation concerning grading of fruits and vegetables is Title II of Public Law 733, which is also known as the Agriculture Marketing Act of 1946.

7. Federal standards for horticulture products are officially recommended, but are not mandatory.

8. The most economical time of the year to buy strawberries is in the spring.

9. Orange, lemon and grapefruit are 3 of the most common citrus fruits.

10. The most economical time of the year to buy apples is in the fall.

Identification

Below is a list of 25 vegetables and 15 fruits. Identify the fresh produce by matching the letter (or number) of the item on the table with the name on the list.

Vegetables

___ 1. Snap Bean
___ 2. Beet
___ 3. Broccoli
___ 4. Cauliflower
___ 5. Celery
___ 6. Cucumber
___ 7. Eggplant
___ 8. Horseradish
___ 9. Mushroom
___ 10. Cantaloupe
___ 11. Onion
___ 12. Zucchini, Pumpkin
___ 13. Pepper
___ 14. Radish
___ 15. Spinach
___ 16. Sweet Corn
___ 17. Turnip
___ 18. Acorn Squash
___ 19. Peas
___ 20. Artichoke
___ 21. Asparagus
___ 22. Endive
___ 23. Popcorn
___ 24. Sweet Potato
___ 25. Brussel Sprouts

Fruits

___ 1. Red Delicious Apple
___ 2. Avocado
___ 3. Blackberry
___ 4. Cherry
___ 5. Thompson Grape
___ 6. Nectarine
___ 7. Peach
___ 8. Papaya
___ 9. Pear
___ 10. Pineapple
___ 11. Plum
___ 12. Strawberry
___ 13. Cranberry
___ 14. Raspberry
___ 15. Lime

Evaluation

This examination tests your ability to select quality fruits and vegetables. To the right of each category write a brief explanation of why you chose the way you did. Indicate judgments with the following notation:

Ex = Excellent

G = Good

F = Fair or passable/acceptance

P = Poor or unacceptable

Vegetable or Fruit:

Reason for Evaluation Mark

Freedom from Injury

Insects
Disease
Mechanical
Weather

Growth Quality

Maturity
Marketable Size
Freedom from Roughness
Trueness to type

Condition

Freshness
Cleanliness
Trimming

Uniformity

Size
Color
Shape

UNIT K: AGRICULTURAL PRODUCTS

PROBLEM AREA: IDENTIFYING AND SELECTING ORNAMENTAL HORTICULTURE PRODUCTS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the spring semester.

The estimated instructional time for this problem area is 15 days, depending on how far the teacher wishes to go in developing identification and selection skills at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be ten days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased. It is strongly recommended that the instructor select only one specific group per area for cut flowers, foliage plants, flowering pot plants, and woody plants for evaluation.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this packet are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-32-D-0542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education, Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the Illinois State Board of Education or its staff.

The teacher's guide, student information sheet, student worksheets laboratory exercise and test questions were developed by Marcia Watman, Department of Vocational and Technical Education, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Field Test Teachers.

TEACHER'S GUIDE

I. Unit: Agricultural products

II. Problem area: Identifying and selecting ornamental horticulture products

III. Objectives: At the close of this problem area students will be able to:

1. Identify and select high quality deciduous and flowering trees, deciduous shrubs, coniferous evergreens, broadleaf evergreens, roses, foliage plants and flowering plants.
2. Compare and select the best of a sequence of plant material.

IV. Suggested interest approaches:

1. Bring in bare-root containerized, and balled and burlapped shrubs and have students compare and contrast them. Ask them which they would buy.
2. Bring in four flowering or foliage plants of the same type and have students compare them for quality characteristics. Ask them which they would buy.

V. Anticipated problems and concerns of students:

Deciduous shade and flowering trees (Please refer to the American Standard for Nursery Stock, pgs. 1-5)

1. What is caliper and how is it measured?
2. At what point should a street tree begin branching?
3. What is the relationship of caliper to tree height?
4. Does the relationship stay the same for slower-growing trees?
5. What should the branching habit be for small trees?
6. If a deciduous tree is pruned for special use, should that be specified?
7. What is the minimum diameter root-spread for nursery growth bare-root trees?
8. What is the minimum diameter ball for nursery grown balled and burlapped trees?
9. What is the ball depth ratio for trees?

10. What size trees and containers are used for container grown trees?

Deciduous shrubs (Please refer to the American Standard for Nursery Stock, pgs. 6-9)

1. What is a cane?
2. How many types of shrubs are there?
3. How are shrubs differentiated?
4. What is the minimum diameter root-spread for nursery grown bare-root shrubs?
5. What is the minimum diameter root-spread for nursery grown balled and burlapped shrubs?
6. What is the ball depth ratio for shrubs?
7. What size shrubs and containers are used for container grown shrubs?
8. What does balled and potted mean for trees and shrubs?

Coniferous evergreens (Please refer to the American Standard for Nursery Stock, pgs. 10-14)

1. What is a specimen evergreen?
2. What is a collected evergreen?
3. How many types of conifers are there?
4. What is the relationship of spread and height for conifers?
5. Can conifers be sold as bare root?
6. What is the minimum diameter ball for a spreading conifer?
7. What is the minimum diameter ball for a cone-type conifer?
8. What is the minimum diameter ball for a columnar-type conifer?
9. What is the ball depth ratio for balled and burlapped coniferous evergreens?
10. What size conifers and containers are used for container grown coniferous evergreens?
11. Can coniferous evergreens be balled and potted?

Broadleaf evergreens (Please refer to the American Standard for Nursery Stock pgs. 15-18)

1. What is the difference between a coniferous and broadleaf evergreen?
2. What is a collected broadleaf evergreen?
3. How many types of broadleaf evergreens are there?
4. For spreading and semi-spreading broadleaf evergreens, is the spread measurement more important than the height?
5. For the upright growing broadleaf evergreens, is the height measurement more important than the spread?
6. Can broadleaf evergreens be sold bare root?
7. What is the minimum diameter ball for spreading-type broadleaf evergreen?
8. What is the minimum diameter ball for an upright-growing broadleaf evergreen?
9. What is the ball depth ratio for balled and burlapped broadleaf evergreens?
10. What size broadleaf evergreens and containers are used for container-grown broadleaf evergreens?
11. What is a balled and potted broadleaf evergreen?

Roses (Please refer to the American Standard for Nursery Stock, pgs. 19-20 and A Manual for Flower Judging, pgs. 79-83)

1. In what forms are roses sold?
2. How many types of roses are there?
3. What constitutes a Grade No. 1 Hybrid Tea Rose?
4. What constitutes a Grade No. 1½ or medium Hybrid Tea Rose?
5. What constitutes a Grade No. 2 Hybrid Tea Rose?
6. What is a floribunda rose?
7. What is a climbing rose?
8. What size roses and containers are used for container-grown roses?
9. What is a grandiflora rose?
10. What does it mean when a rose is peeling?

11. What is a bullhead bud?

12. What is a peanut rose flower?

Foliage plants (Please refer to A Manual for Flower Judging, pgs. 51-54)

1. What constitutes a foliage plant?

2. When considering the physical appearance of a foliage plant, what is the proper balance between the plant and its container?

3. What are the two types of plant forms for foliage plants?

4. What are some characteristics of the upright-type plant form for foliage plants?

5. What are some characteristics of the trailing type plant form for foliage plants?

6. What are some examples of upright and trailing types of foliage plants?

7. What kind of "weight" should the leaves be given on a particular foliage plant?

8. What does it mean to "clothe" the plant?

9. What are some merits of a foliage plant?

10. What are some faults associated with foliage plants?

Flowering plants (Please refer to A Manual for Flower Judging, pgs. 23-31)

1. When considering potted flowering plants, should the plants compared have the same number of individual plants per pot?

2. Why are stems important when considering potted chrysanthemum plants?

3. What should the floral display look like when purchasing a potted chrysanthemum plant?

4. Are small or large flowers better for potted chrysanthemum plants?

5. How sharp should potted chrysanthemum flowers be?

6. What is a crown bud on spray type cut chrysanthemums?

7. What is the terminal bud on spray type cut chrysanthemums?

8. What are the three spray types of cut chrysanthemums?

9. When are spray types of chrysanthemums disbudded?

10. What are the inflorescences that a spray type cut chrysanthemum can have?

11. What does pollen indicate when considering a flowering plant?

VI. Suggested learning activities and experiences:

1. Lead students into a discussion of nursery plant material by showing them a bare-root shrub and a balled and burlapped shrub. Have students compare and contrast the two plants. Record questions and tentative answers.

2. Visit a local nursery and have students discuss the nursery material available and their quality components. Refer to the American Standard for Nursery Stock for evaluation consideration.

3. Take a walking field trip around the school grounds and have students discuss qualitatively the established plantings and the importance of selecting quality plant material.

4. Visit the local garden center and have students discuss the plant materials available and their quality characteristics.

5. Have students read the Information Sheet "Roses" and discuss with them the quality characteristics to look for when selecting roses for purchase.

6. Show transparencies on roses.

7. Have the students complete the Worksheet "Roses."

8. Display a set of four woody plants of the same type, one set of four cut flowers, one set of four flowering pot plants and one set of four foliage plants. Have students discuss the differences among the plant material in each case. Record questions and tentative answers. After discussing quality characteristics of the sets of material, have the students complete the Laboratory Exercise "Evaluating Ornamental Horticulture Products."

VII. Application procedures:

1. From the problem area the student should be able to apply the skills learned when purchasing plant material for beautification purposes.

2. Skills learned in this problem area will aid students in working in a garden center, nursery or greenhouse situations.

3. The student should be able to apply the skills learned in contest activities at the local county, state and national levels.

4. The student should be able to adapt the skills learned here for use in their S.O.E.P.'s.

VIII. Evaluation:

1. Collect and grade Laboratory Exercise.
2. Administer and evaluate a written exam at the completion of this problem area.
3. Administer an exam whereby students must selectively choose from a group of plants in order from best to worst.

IX. References and aids:

1. American Standard for Nursery Stock

   American Association of Nurserymen
   230 Southern Bldg.
   Washington, D.C. 20005

2. University of Illinois, Vocational Agriculture Service,
   434 Mumford Hall, 1301 W. Gregory, Urbana, IL 61801

   a. "A Manual for Flower Judging"
   b. Subject matter Unit 5010a "Growing Flowering Annuals"

3. *A. B. Morse Company, Countryside Publications
   1845 N. Forwell, Milwaukee, WI 53202, (414 - 272-6700)

   a. "Roses"
   b. "Rose Handbook"

*These may be found at the local garden center or department stores that carry horticulture references.

INFORMATION SHEET

ROSES

There are six classes of roses available, which lend themselves differently for use in the landscape. The principal classes of rose are floribunda, hybrid tea and grandiflora. Roses are also available in bush, climber, tree and miniature forms.

The floribunda rose is a bush form, growing 18-30 inches tall. This rose bears masses of flowers until frost and is hardier than other roses, but still needs winter protection.

The hybrid tea rose is the most popular bush rose. It has large buds on long stems and its disease resistant flowers are excellent for cut rose purposes.

The grandiflora rose combines the large buds and the long stems of the hybrid teas with floribunda flower clusters. These roses are also excellent for cutting and are somewhat disease resistant.

Climber roses should be tied to a trellis or arbor; otherwise, the long, vigorous growing canes will lie on the ground.

Tree roses are not a real class of rose, but the result of a rose plant grafted to a trunk. Tree roses may grow to 8-10 feet. They are more expensive and are susceptible to winter damage.

Miniature roses are duplicates of the larger types. These grow to about 1 foot, have small flowers and can be of the hybrid tea, floribunda, climber or tree rose types.

When selecting roses for purchase, decisions as to the health, vigor and form the rose will be sold in should be considered.

Roses are graded in descending order. Grade Number 1 is the largest and must exhibit 3 strong canes. Any branch more than three inches above the graft union is not considered a cane. Number 1½ or Number 2 roses are smaller and less expensive. Regardless of grade, the rose bark should be checked to see if it is alive.

Roses can be bought as bare-root or container grown. Bare-root plants are dug in late fall and the soil is removed. The plant is wrapped in a moisture-retaining material and stored at a low temperature to insure dormancy.

Container-grown roses are actively growing and may be in bloom. It is not unusual to find Number 1½ and 2 grade roses sold in three and five gallon containers. These plants have minimal transplant shock,as an intact soil ball is still established on the plant.

WORKSHEET

ROSES

1. Define or explain the following terms:

   Grandiflora rose

   Floribunda rose

   Hybrid tea rose

   Miniature rose

   Tree rose

   Climber rose

   No. grade rose

2. What quality characteristics are considered when selecting cut roses, bare-root roses and container-grown roses?

   Cut roses:
   Bare-root roses:
   Container-grown roses:

STUDENT WORKSHEET

BEDDING PLANTS

INSTRUCTIONS: Please read VAS 5010a before completing this worksheet.

1. What is the most popular bedding plant?

2. What is the average date of last 32° freeze in the spring? (Check the map on page 3 of VAS 5010 for the appropriate area.)

3. Compare the methods of acquiring bedding plants.

4. What factors should be considered when selecting bedding plants for a purchase?

LABORATORY EXERCISE

EVALUATING ORNAMENTAL HORTICULTURE PRODUCTS

I. Objective:

Given a ring (a total of four specimens) of cut flowers, foliage plants, flowering pot plants or woody plants, the student will determine the proper placement of the plant material from best quality to poorest quality using selection criterion as discussed in class and in this exercise introduction.

II. Materials:

1. Scorecards
2. Ring of cut flowers, labeled A, B, C and D

   Suggested cut flowers:
   - Chrysanthemum - Spray type
   - Chrysanthemum - Standard type
   - Carnations
   - Snap dragons
   - Roses - single stem
   - Gladiolus

3. Ring of foliage plants, labeled A, B, C and D

   Suggested foliage plants:
   - Chinese Evergreen
   - Grape Ivy
   - Scheffalera
   - Benjamina Fig (Ficus benjamina)
   - Dumbcane (Diffenbachia)

4. Ring of flowering pot plants, labeled A, B, C and D

   Suggested flowering pot plants
   - Calceolaria
   - Geranium
   - Poinsettia
   - Cineraria
   - Cyclamen
   - African Violet

5. Ring of woody plants, labeled A, B, C and D

   Suggested woody plants:
   - Deciduous Shade and Flowering Trees
     - Red Maple
     - River Birch
     - Ginkgo

Deciduous shrubs
    Slender Deutzia
    Potentilla
    Alpine Currant

Coniferous evergreens
    Pfitzer Chinese Juniper
    Andorra Juniper
    Canadian Hemlock

Broadleaf Evergreens
    Rhododendron
    Boxwood
    Oregon grape holly

III. Procedure:

1. Let each student study either on their own or in a small group the following terminology for evaluating ornamental horticulture products. If possible, demonstrate a ring with them.

Criterion for Cut Flowers:

Condition: uniformity; freedom from bruises and blemishes
Form: uniformity; maturity; correct shape; regular petalage
Stem and Foliage: uniformity; strength and/or straightness; foliage quality; size and proportion
Color: uniformity; intensity; clarity; trueness to variety
Size: uniformity

Criterion for Flowering Pot Plants:

Cultural Perfection
Floriferousness
Size of Plant
Color of Bloom
Size of Bloom

Criterion for Foliage Plants:

Symmetry: form consistent with variety of plant
Proportion: plant to pot
Stem: strong and proportionate
Foliage: abundant, glossy, green or vivid colored foliage according to variety and type of plant; free of insect and disease damage; free from residues and mechanical damage
Flowers: disadvantages
Support: proper scale for type of plant

Criterion for Woody Plants:

Caliper/Height Measurement
Bare Root Specifications
Balling and Burlapping Specifications
Container Grown Specifications

Note: Students should consult the American Standard for Nursery Stock, pgs. 1-17, for more specific information.

2. Evaluate one or more ring(s) of cut flowers. The scorecard should indicate the placement from best quality to poorest quality.
3. Evaluate one or more ring(s) of flowering pot plants. The scorecard should indicate the placement from best quality to poorest quality.
4. Evaluate one or more ring(s) of foliage plants. The scorecard should indicate the placement from best quality to poorest quality.
5. Evaluate one or more ring(s) of woody plants. The scorecard should indicate the placement from best quality to poorest quality.

EVALUATING ORNAMENTAL HORTICULTURE PRODUCTS

CUT FLOWERS

Cut Flower-type	Criterion for Selection				
	Condition	Form	Stem and Foliage	Color	Size

EVALUATING ORNAMENTAL HORTICULTURE PRODUCTS

FOLIAGE PLANTS

Foliage Plant	Criterion for Selection					
	Symmetry	Proportion	Stem	Foliage	Flowers	Support

EVALUATING ORNAMENTAL HORTICULTURE PRODUCTS

FLOWERING POT PLANTS

Flowering Pot Plant	Criterion for Selection				
	Cultural Perfection	Floriferousness	Size of Plant	Color of Bloom	Size of Bloom

EVALUATING ORNAMENTAL HORTICULTURE PRODUCTS

WOODY PLANTS

Nursery Material - Woody Plants	Criterion for Selection			
	Caliper/Height Measurement	Symmetry	Balling & Burlapping	Container Grown

TEACHER'S KEY TO WORKSHEET

ROSES

1. Define or explain the following terms:

Grandiflora rose:

The grandiflora rose combines the large buds and long stems of the hybrid teas with floribunda flower clusters. These roses are also excellent for cutting and are somewhat disease resistant.

Floribunda rose:

The floribunda rose is a bush form, growing 18-30 inches tall. This rose bears masses of flowers until frost and is hardier than other roses, but still needs winter protection.

Hybrid tea rose:

The hybrid tea rose is the most popular bush rose. It has large buds on long stems and its disease resistant flowers are excellent for cut rose purposes.

Miniature rose:

Miniature roses are duplicates of the larger types. These grow to about 1 foot, have small flowers and can be of the hybrid tea, floribunda, climber or tree rose types.

Tree rose:

Tree roses are not a real class of rose, but the result of a rose plant grafted to a trunk. Tree roses may grow to 8-10 feet. They are more expensive and are susceptible to winter damage.

Climber rose:

Climber roses should be tied to a trellis or arbor; otherwise, the long, vigorous growing canes will lie on the ground.

No. grade rose:

Roses are graded in descending order. Grade Number 1 is the largest and must exhibit 3 strong canes. Any branch more than three inches above the graft union is not considered a cane. Number 1½ or Number 2 roses are smaller and less expensive. Regardless of grade, the rose bark should be checked to see if it is alive.

2. What quality characteristics are considered when selecting cut roses, bare-root roses and container-grown roses?

Cut roses:
Bare-root roses:
Container-grown roses:

When selecting roses for purchase, decisions as to the health, vigor and in what form the rose will be sold should be considered.

Roses can be bought as bare-root or container-grown. Bare-root plants are dug in late fall and the soil is removed. The plant is wrapped in a moisture-retaining material and stored at a low temperature to insure dormancy.

Container grown roses are actively growing and may be in bloom. It is not unusual to find Number 1½ and 2 grade roses sold in three and five gallon containers. These plants will have minimal transplant shock, as an intact soil ball is still established on the rose plant.

TEACHER'S KEY TO STUDENT WORKSHEET

BEDDING PLANTS

INSTRUCTIONS: Please read VAS 5010a before completing this worksheet.

1. What is the most popular bedding plant?

The petunia is the most popular bedding plant.

2. What is the average date of a last 32° freeze in the spring? (Check the map on page 3 of VAS 5010 for the appropriate area.)

The range of last freeze dates is from April 5 to May 5.

3. Compare the two methods of acquiring bedding plants.

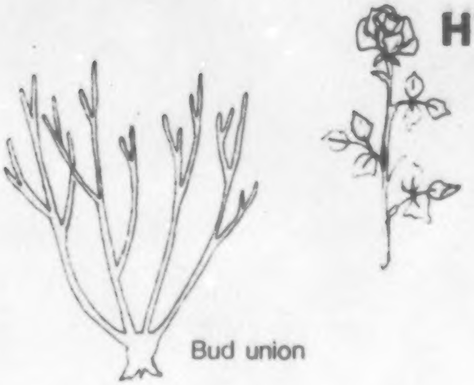
Directly seeding the smaller seed types may result in spot patches and late blooms. Direct-seeded plants need to be thinned after germination.

Plants or transplants are available in their own soil. These can be purchased in sell-paks, usually 4-6 plants per cell-pak. Plants may also be available in individual pots. Transplants can be properly placed when transplanting, avoiding the thinning process. Some of these plants may be in bloom when purchased which makes it easy to decide which color or colors are wanted.

4. What factors should be considered when selecting bedding plants for a purchase?

The plants should be insect free and uniform in height. They should also display normal-size green leaves. Generally, a healthy plant will have healthy, nicely colored flowers, but flowers should be a last consideration.

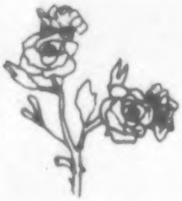
GROWTH HABITS OF MODERN ROSES



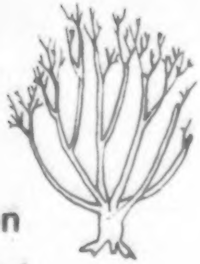
HYBRID TEA

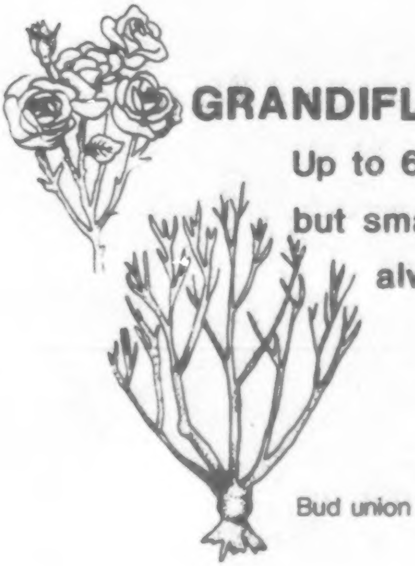
4' to 5' high single or double flowers usually alone (occasionally in clusters of 3 to 5) on long stems: always grafted

FLORIBUNDA



About 3' high: many small flowers in huge clusters on short stems: usually grafted





GRANDIFLORA

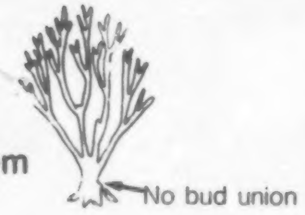
Up to 6' high: flowers resemble hybrid teas, but smaller and in clusters of 5 to 7: always grafted

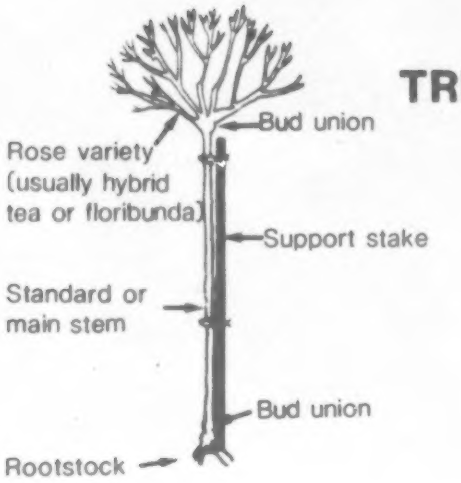
GROWTH HABITS OF MODERN ROSES

(continued)

MINIATURES

Usually very small floribundas or hybrid teas, some natural climbers: always grow on their own root system


No bud union

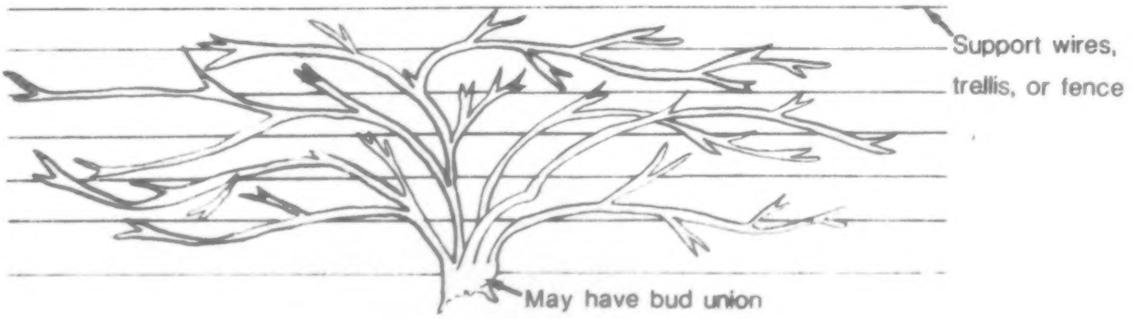

Bud union
Rose variety (usually hybrid tea or floribunda)
Support stake
Standard or main stem
Bud union
Rootstock

TREE ROSE

Any rose grafted to a tall trunk or standard

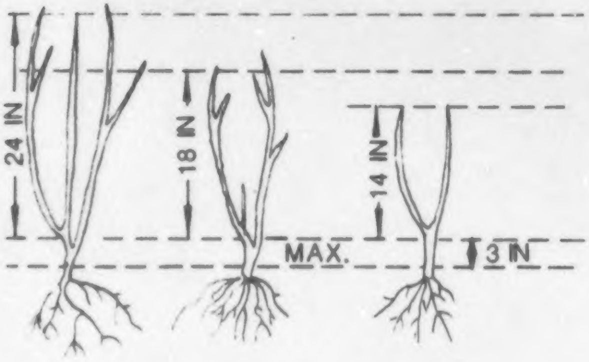
CLIMBER

6″ to 20″ tall: any type flowers: some are grafted


Support wires, trellis, or fence
May have bud union

GRADING ROSES

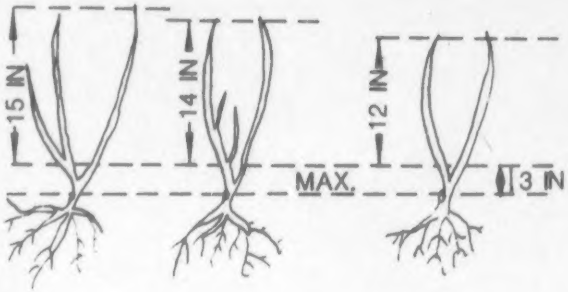
CLIMBING ROSES


24 IN
18 IN
14 IN
MAX.
3 IN

NO. 1 NO. 1 1/2 NO. 2

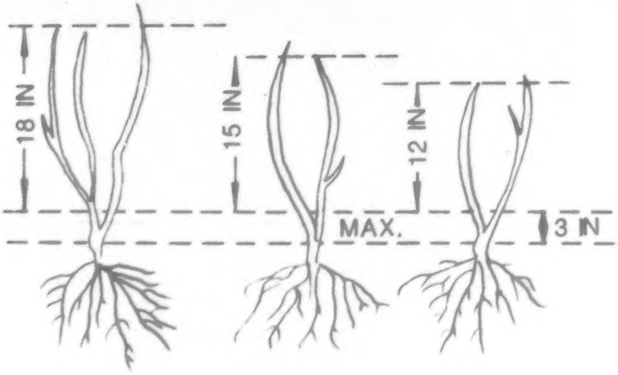
Branched not higher than 3 inches above bud union

FLORIBUNDA ROSES


15 IN
14 IN
12 IN
MAX.
3 IN

GRADE NO. 1 NO. 1 1/2 NO. 2

HYBRID TEA, TEA, GRANDIFLORA ETC. ROSES


18 IN
15 IN
12 IN
MAX.
3 IN

NO. 1 NO.1 1/2 NO. 2

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

IDENTIFYING AND SELECTING ORNAMENTAL HORTICULTURE PRODUCTS

True (+) - False (0)

+ 1. There are six classes of roses.

0 2. All roses are of the bush type.

0 3. A hybrid tea rose is a flower you can use to make tea.

+ 4. Climber roses need some support for climbing.

0 5. A Grade No. 3 rose is better than a No. 1 rose.

0 6. A Grade No. 1 rose is always sold bare-root.

0 7. Container-grown roses exhibit transplant shock.

+ 8. Quality cut flowers have strong stems and clean, bright flowers.

+ 9. The size of a cut flower doesn't matter, as long as it shows uniform quality.

0 10. The symmetry of foliage on a foliage plant doesn't matter, just as long as it is green.

0 11. It is an advantage for foliage plants to have flowers that can add color.

0 12. The size of the soil ball for nursery plant material doesn't matter, as long as some roots are present.

+ 13. The number and length of canes for shrubs is important.

0 14. Caliper refers to the number of branches a tree has.

+ 15. A tree that is in bush form will start to branch close to the ground, similar to a shrub.

+ 16. A clump tree has at least two main stems starting at the ground.

0 17. A topiary is a low-growing branch.

+ 18. For container-grown nursery stock, the 1 gallon, 2 gallon and 5 gallon containers are the most common.

0 19. Dwarf and semi-dwarf shrubs reach only 24 inches in height.

+ 20. There is a relationship between the height of the plant and the root spread for bare-root deciduous shrubs.

+ 21. A plant collected from wild or native stands may be considered nursery grown after two proper growing seasons.

0 22. For a semi-spreading coniferous evergreen the height and spread will always be the same.

+ 23. A container-grown conifer will be grown in the proper container to insure the proper shape when removed.

0 24. Broadleaf evergreens and coniferous evergreens have the same specifications in all areas.

+ 25. Under certain soil conditions, some plants may have root systems that will not fit into the proposed standards.

Matching

F	1.	Hybrid Tea Rose	A.	Any rose grafted to a tall trunk
J	2.	Ball Depth Ratio	B.	3' high; usually grafted
A	3.	Tree rose	C.	The amount of flowers on a plant
C	4.	Floriferousness	D.	Very small; grow on own roots
H	5.	Bud union	E.	Up to 6'; clustered flowers; grafted
G	6.	Climber rose	F.	4'-5' high; always grafted
I	7.	Cane	G.	6'-20' tall; needs support
E	8.	Grandiflora rose	H.	Place where rose is grafted
D	9.	Miniature rose	I.	Growing portion of a plant
B	10.	Floribunda rose	J.	Amount of soil encompassed in burlap for B & B nursery material

UNIT L: Landscape Design Establishment and Maintenance

PROBLEM AREAS:

1. Designing and drawing a landscape plan
2. Establishing and maintaining a turf area
3. Constructing patios and walkways
4. Transplanting and caring for trees and shrubs

UNIT L: LANDSCAPE DESIGN, ESTABLISHMENT, AND MAINTENANCE

PROBLEM AREA: DRAWING AND DESIGNING THE LANDSCAPE PLAN

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The materials in this problem area were selected and written with the following assumptions:

1. This problem area will be taught after the students have received instruction in woody plant identification.
2. It is understood that the information sheets cover basic principles of design and the plant materials lists are not complete lists.

The estimated instructional time for this problem area is 10-20 days, depending on how far the teacher wishes to go in developing landscape design skills at the first year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be 7 days or less. If the students are to be involved in other activity exercises, such as drawing landscapes, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, information sheets, student worksheets, transparencies, and test questions were developed by Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Material for the information sheets was taken from the University of Illinois Cooperative Extension Service Circular 1111, Landscaping Your Home. The transparency masters were prepared by the Vocational Agriculture Service, University of Illinois.

TEACHER'S GUIDE

I. Unit: Landscape design, establishment and maintenance

II. Problem area: Designing and drawing the landscape plan

III. Objectives: At the close of this problem area, students will:

1. Develop an understanding of basic landscape design principles.
2. Be able to identify and correctly use symbols in landscape designing.
3. Be able to complete a landscape plan, after determining the needs of the family and site.

IV. Suggested interest approaches:

1. Have a local landscape architect or landscape designer appear as a guest speaker.
2. Take a field trip in town to well-designed home landscapes. Point out elements of the designs which are particularly well done.
3. Let the students know that awards for landscape plans can be won through FFA competition.
4. Ask the students if any of them would be interested in pursuing a career as a landscape designer or landscape architect.

V. Anticipated problems and concerns:

1. Why are conical trees or shrubs difficult to incorporate in a landscape design?
2. How do large concrete driveways detract from a home?
3. What is the public area?
4. What is the outdoor living area?
5. What is the service or utility area?
6. What is the primary purpose of trees placed in the public area?
7. What is the center of interest and balance point of all homes?
8. Why is it helpful to have different symbols for various plant material?
9. What equipment is needed in order to complete a landscape design?

VI. Suggested learning activities and experiences:

1. Have the students read Information Sheets "Establishing Landscape Needs," "Starting a Plan," and "Analyzing the Site."

2. Have the students complete the Student Worksheet for Information Sheets "Establishing Landscape Needs," "Starting a Plan," and "Analyzing the Site."

3. Provide the students with the base plan of a home in the neighborhood. Visit the home, and have the students conduct a site survey.

4. Use the transparency set to show the students the various steps involved in landscape design.

5. Distribute and discuss the Information Sheet "Equipment Used in Technical Drawing."

6. Provide a hypothetical family inventory for the home they visited and have the students practice "goose egg" sketches.

7. Have the students read Information Sheets "Selecting Plants to Fit Your Design," "Fitting Trees to Your Plan," and "Fitting Shrubs to Your Plan." Discuss the material covered. Use the transparencies provided to explain form, texture, color, simplicity, variety, balance, emphasis, sequence, and scale.

8. Have the students complete the Student Worksheet for Information Sheets "Selecting Plants to Fit Your Design," "Fitting Trees to Your Plan," and "Fitting Shrubs to Your Plan."

9. Have the students read the Information Sheets "Designing the Public Area" and "Designing the Living Area."

10. Have the students complete the Student Worksheet for Information Sheets "Designing the Public Area" and "Designing the Living Area." Discuss the material covered.

11. Show VAS Slidefilm 642, "Landscaping Do's and Don'ts."

12. Discuss landscape planning symbols using the transparency included in this problem area.

13. Demonstrate proper labeling techniques and have the students practice printing. Refer to transparencies.

14. Have the students draw a landscape plan for the house previously visited. Use the Information Sheets "Trees for Design," "Shrubs for Design," "Conifers for Design," and "Ground Covers for Design" as aids in selecting plant materials.

VII. Application procedures:

1. The design skills learned should be applied in home situations.
2. The design skills learned will aid students working for landscaping firms, garden centers and nurseries.

VIII. Evaluation:

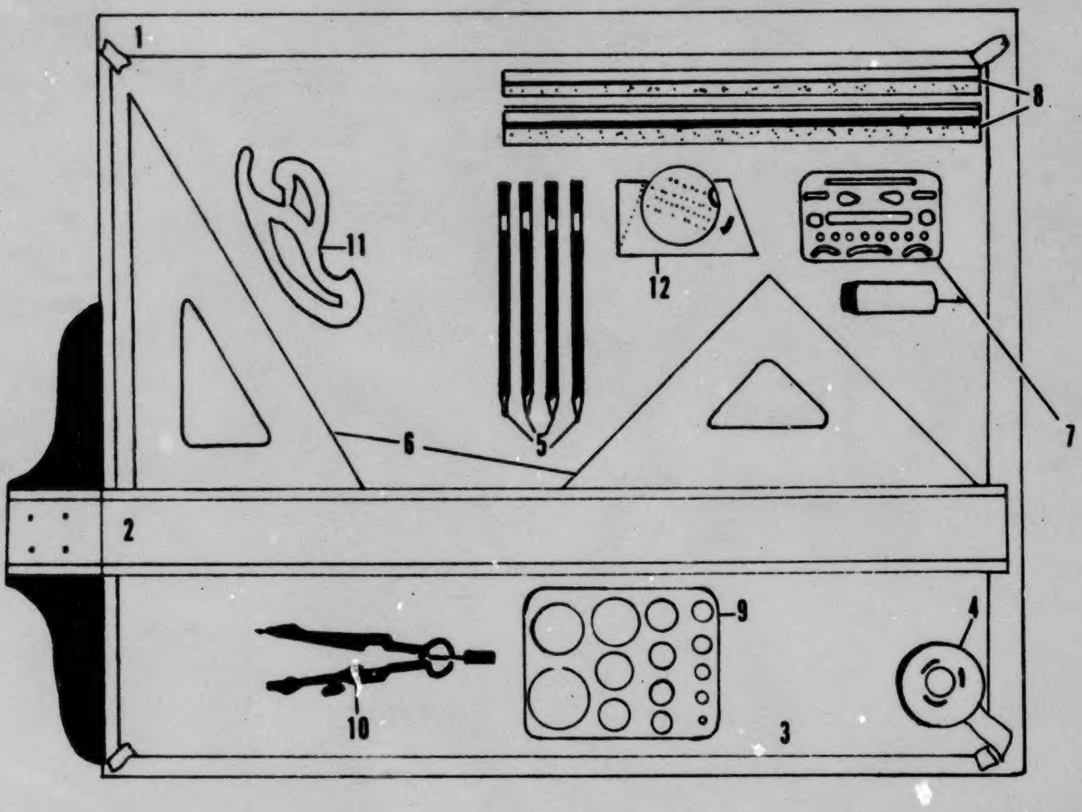
1. Collect and grade worksheets.
2. Administer an objective paper and pencil test at the completion of this problem area.
3. Collect and grade the landscape designs using the Information Sheet, "Suggested Landscape Planting Plan Evaluation Values."

IX. References and aids:

1. University of Illinois Cooperative Extension Service:
   Circular 1111, Landscaping Your Home
   Circular 1178, Designing an Energy-Efficient Home Landscape
2. Vocational Agriculture Service Filmstrip #642 "Landscaping Do's and Don'ts" and the "Landscaping Do's and Don'ts Study Guide."
3. Sample Test Questions and Teacher's Key.
4. Student Worksheets included in this problem area.
5. Outdoor Living available through Vocational Agriculture Service.
6. Transparencies
7. Information Sheets included in this problem area:
   a. "Equipment Used in Technical Drawing"
   b. "Suggested Landscape Planting Plan Evaluation Values"
   c. "Trees for Design"
   d. "Shrubs for Design"
   e. "Conifers for Design"
   f. "Ground Covers for Design"
   g. "Establishing Landscape Needs"
   h. "Starting a Plan"
   i. "Analyzing the Site"
   j. "Selecting Plants to Fit Your Design"
   k. "Fitting Trees to Your Plan"
   l. "Fitting Shrubs to Your Plan"
   m. "Designing the Public Area"
   n. "Designing the Living Area"

INFORMATION SHEET

EQUIPMENT USED IN TECHNICAL DRAWING



1. Drawing Board: At least one side must be true and the surface must be smooth (minimum size 20" x 24")

2. T-Square: The working edge of the T-square must be straight and 90° to the edge of the drawing board. Whenever drawing hold the T-square firmly to the edge of the board. Use the top side of the T-square to draw horizontal lines.

3. Drawing Paper: Cream or white vellum or tracing paper are commonly used. Many sizes are available. Use the T-square to line up the top edge of the drawing paper. Fasten the two free corners of the paper while holding it firmly in place. Then, smooth the paper from the center using fingernails and fasten the remaining corners.

4.	Drafting Tape:	Is commonly used to secure drawing paper.
5.	Drawing Pencil:	Select medium grade (3H, 2H, H, F, HB, B) pencils for drawing. 3H grade pencils have harder lead than a B grade pencil, and thus, will provide a lighter line. Keep your pencil sharp! Always pull a pencil across the paper while rolling it between the thumb and forefinger. Also, when drawing hold the pencil at a 60° angle to the paper.
6.	Triangles:	The triangles commonly used are the 45° triangle and the 30° x 60° triangle. Place the triangles on the top side of the T-square to draw vertical and angled lines. Be sure to hold the T-square snug to the board.
7.	Eraser and Erasing Shield:	Use together to remove unwanted lines. Think about every line before it is drawn to avoid erasures.
8.	Scale:	For landscape design purposes the architect's scale is recommended. However, it is useful to have an engineer's scale on hand. An architect's scale is divided into eights while the engineer's scale is divided into tenths. Never use the edge of a scale for drawing purposes.
9.	Circle Templet:	This can be used as a guide for the many circles drawn in a landscape plan.
10.	Compass:	The compass can be used to make the larger curves not possible with the circle templet.
11.	French curves:	Irregular curves can be drawn with the French curve instrument.
12.	Ames Lettering Instrument:	This is used to draw light parallel guidelines. For lettering simply slide it along the top edge of the T-square.

INFORMATION SHEET

SUGGESTED LANDSCAPE PLANTING PLAN EVALUATION VALUES*

		Plan 1	Plan 2	Plan 3	Plan 4
A. FUNCTION (39 points)					
How well do the use areas function related to the building(s)?					
1. Public area (front yard)	10				
2. Private area (outdoor living space)	10				
3. Service area (veg. garden, compost, etc.)	10				
Circulation					
1. Auto access and usage	5				
2. Pedestrian circulation	4				
B. AESTHETICS (36 points)					
1. Harmony and unity. Do the component elements of the plan (plants, lawns, fences, walls, patios, building(s) fit together into an attractive, pleasant, overall whole for outdoor living, work, and play?	15				
2. Accent. Are important areas (front door, patio, etc.) emphasized with materials that contrast in form, color or texture?	5				
3. Screen. Are least desirable items (trash cans, compost heaps, etc.) screened from view?	4				
4. Views. Are interesting and attractive views planned (a) from the house, (b) on the grounds, (c) off the grounds?	4				

		Plan 1	Plan 2	Plan 3	Plan 4
5. Compatibility. Does the plan, the plantings, and materials used complement the architecture of the buildings?	4				
6. Balance. Is there a well balanced use of sufficient variety of plant and construction materials (color, form, and texture) to provide interest, but not confusion, or is there a monotonous repetition of these elements?	4				
C. SCALE (Size Relationships) (15 points)					
1. Are the elements of the plan in scale with the building and with each other?	15				
D. PRESENTATION (10 points)					
1. Is the plan easily understood, well delineated?	5				
2. Is the necessary marginal information shown (scale, north point, client, location)?	5				
	100				

My rank or placing (Plan Number) ____________

*Adapted from Bulletin No. 4, "National FFA Contests"

INFORMATION SHEET

TREES FOR DESIGN

Tree Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Ash, Green	Ht. 50-60' Sp. 25-30'	Irregular	M		SU - Medium Green FA - Yellow	.Sun .Tolerant of most soils
Ash, White	Ht. 50-80' Sp. 50-80'	Rounded	M		SU - Bright Green FA - Yellow to Maroon	.Sun .Rich, moist, well-drained soil
Beech, European	Ht. 60-80' Sp. 50-70'	Oval	M		SU - Dark Green FA - Bronze	.Sun .Moist, well-drained soil
Birch, River	Ht. 40-70' Sp. 30-60'	Pyramidal	MF		SU - Med. Green FA - Yellow	.Sun .Sun or partial shade .Moist soil
Coffeetree, Kentucky	Ht. 80' Sp. 30-40'	Oval	M		SU - Light Green FA - Not Effective	.Sun .Tolerant of most soils
Corktree, Amur	Ht. 30-45' Sp. 30-40'	Rounded	M		SU - Dark Green FA - Yellow	.Sun .Tolerant of most soils .Air pollution tolerant
Crabapple	Ht. 15-40' Sp. 15-30'	Varied	M	X	SU - Varied FA - Varied	.Varied
Ginkgo	Ht. 50-80' Sp. 40'	Irregular	M		SU - Light Green FA - Yellow	.Sun .Very tolerant of soils .Use only male trees
Hawthorne, Washington	Ht. 30' Sp. 20-25'	Oval	M-F	X	SU - Glossy, Dark Green FA - Red-Bronze	.Sun .Good soil

Tree Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Hackberry, Common	Ht. 50-70' Sp. 50'	Vase	M		SU - Light to Med. Green FA - Yellow	.Sun .Tolerant of most soils
Honeylocust, Common	Ht. 75' Sp. 40-50'	Spreading	F		SU - Med. Green FA - Yellow	.Sun .Tolerant of most soils
Horsechestnut, Common	Ht. 50-70' Sp. 30-40'	Oval	C	X	SU - Dark Green FA - Yellow Brown	.Sun or partial shade .Moist, but well drained
Linden, American	Ht. 60-80' Sp. 30-50'	Rounded	C		SU - Dark Green FA - Yellow Green	.Sun or partial shade .Tolerant of most soild
Linden, Littleleaf	Ht. 50-70' Sp. 40'	Pyramidal	M		SU - Dark Green FA - Yellow Green	.Sun .Tolerant of most soils
Magnolia, Saucer	Ht. 20-30' Sp. 20-30'	Rounded	C	X	SU - Medium Green FA - Bronze	.Sun .Moist, acid soil
Maple, Amur	Ht. 20' Sp. 10-20'	Vase	F -M		SU - Dark Glossy Green FA - Red, Yellow	.Sun or partial shade .Tolerant of most soils
Maple, Norway	Ht. 40-50' Sp. 30-50'	Rounded Dense	MC		SU - Dark Green FA - Yellow Green	.Sun .Tolerant of most soils
Maple, Red	Ht. 40-60' Sp. 30-40'	Oval	M		SU - Med. Green FA - Red to Yellow	.Sun or shade .Tolerant of most soils .Tolerant of wet soil
Maple, Sugar	Ht. 60-120' Sp. 50-80'	Upright Oval	M		SU - Med.-Dark Green FA - Yellow, Orange, Red	.Sun or partial shade .Good, well-drained soil

Tree Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Oak, Northern Red	Ht. 70' Sp. 60-75'	Rounded	M		SU - Dark Green FA - Red-Bronze	.Sun or partial shade .Tolerant of most soils
Oak, White	Ht. 50-80' Sp. 50-80'	Rounded	MC		SU - Dark Green FA - Red to Brown	.Sun .Well-drained soil but quite tolerant
Pear, Bradford Callery	Ht. 30-50' Sp. 20-35'	Pyramidal	MF	X	SU - Dark Green FA - Maroon	.Sun .Tolerant of most soils .Pollution tolerant
Redbud, Eastern	Ht. 20-25' Sp. 15-30'	Broad Rounded	MC	X	SU - Blue, Green FA - Yellow	.Sun or Partial Shade .Good, well-drained soil
Serviceberry, Downy	Ht. 18-25' Sp. 12'	Upright Oval	MF	X	SU - Med. Green FA - Yellow-Red	.Sun or shade .Good, well-drained soil
Sycamore, American	Ht. 75-100' Sp. 50-70'	Rounded	C		SU - Yellow Green FA - Brown	.Sun .Moist, rich soil
Tuliptree	Ht. 80' Sp. 30-40'	Oval	M		SU - Yellow Green FA - Yellow	.Sun .Moist, well-drained soil
Willow, White	Ht. 75-100' Sp. 50-100'	Rounded	F		SU - Yellow-Green FA - Not Effective	.Sun .Moist, wet soils

INFORMATION SHEET

SHRUBS FOR DESIGN

Shrub Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Barberry, Japanese	Ht. 5-7' Sp. 4-7'	Round Broad	MF		SU - Bright Green FA - Orange to Scarlet	.Sun .Tolerant of most soils
Cinquefoil, Bush (Potentilla)	Ht. 3-5' Sp. 3-4'	Rounded	MF	X	SU - Bright Green FA - Yellow Brown	.Sun or partial shade .Tolerant of most soils
Clethra, Summersweet	Ht. 3-10' Sp. 3-8'	Oval Erect	M	X	SU - Deep Bright Green FA - Yellow Green	.Sun or shade .Requires moist acid soil
Cotoneaster, Cranberry	Ht. 2-3' Sp. 5-8'	Low Mounding	F		SU - Glossy Dark FA - Reddish	.Sun or partial shade .Very tolerant of soils
Cotoneaster, Hedge	Ht. 10-15' Sp. 6-10'	Upright Rounded	M		SU - Glossy Dark Green FA - Reddish	.Sun .Very tolerant of soils
Currant, Alpine	Ht. 4-6' Sp. 6-12'	Erect	MF		SU - Bright Green FA - Yellow	.Sun or shade .Tolerant of most soils
Deutzia, Slender	Ht. 3-4' Sp. 3-4'	Rounded	M-F	X	SU - Yellow Green FA - Yellow Green	.Sun or light shade .Tolerant of most soils
Dogwood, Redozier	Ht. 8-10' Sp. 8-10'	Rounded	MC		SU - Medium Green FA - Purple Red	.Sun or shade .Very tolerant of soils
Euonymus, Dwarf Winged	Ht. 6-8' Sp. 5-6'	Rounded	M		SU - Light Green FA - Red	.Sun or shade .Very tolerant of soils
Forsythia, Border	Ht. 8-10' Sp. 8-10'	Rounded	M	X	SU - Yellow Green FA - Not Effective	.Sun .Prefers good soil

Shrub Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Fothergilla, Dwarf	Ht. 2-3' Sp. 3-4'	Irregular	MC	X	SU - Dark Green FA - Yellow to scarlet	.Sun or partial shade .Well-drained acid soil
Honeysuckle, Tatarian	Ht. 9-12' Sp. 10-12'	Rounded	M	X	SU - Blue Green FA - Not Effective	.Sun or partial shade .Tolerant of most soils
Lilac, Common	Ht. 8-20' Sp. 6-15'	Rounded	M-C	X	SU - Gray-Green to Blue-Green FA - Not Effective	.Sun .Tolerant of most soils
Mockorange, Minnesota Snowflake	Ht. 8' Sp. 4-6'	Rounded	M	X	SU - Medium Green FA - Not Effective	.Sun .Tolerant of most soils
Privet, Amur	Ht. 10-15' Sp. 6-10'	Erect Oval	MF		SU - Dark Green FA - Not Effective	.Sun or shade .Tolerant to all but wet soil
Rhodedendron, Wilson	Ht. 2-4' Sp. 4-6'	Rounded	M	X	Glossy Dark Green (Evergreen)	.Sun or partial shade .Rich, well-drained acid soil
Spirea, Anthony Water	Ht. 5-8' Sp. 3'	Rounded to Flat Topped	MF	X	SU - Red-Green FA - Reddish	.Sun .Tolerant of most soils
Spirea, Bridal Wreath	Ht. 5-8' Sp. 6-6'	Upright Rounded	MF	X	SU - Light Blue-Green FA - Orange	.Sun .Tolerant or most soils
St. Johnswort, Shrubby	Ht. 3' Sp. 3'	Round	MF	X	SU - Blue Green FA - Not Effective	.Sun or partial shade .Tolerant of most soils
Viburnum, Arrowwood	Ht. 8-15' Sp. 6-12'	Upright	M	X	SU - Dark Glossy Green FA - Yellow to Purple	.Sun or partial shade .Tolerant of most soils

Shrub Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Viburnum, Compact European Cranberrybush	Ht. 5-6' Sp. 4-5'	Rounded	MC	X	SU - Medium Green FA - Red	.Sun or shade .Tolerant of most soils
Viburnum, Doublefile	Ht. 8-10' Sp. 9-12'	Rounded, Horizontally Branched	M	X	SU - Dark Green FA - Red-Purple	.Sun or partial shade .Prefers moist well-drained soil
Vibunum, Koreanspice	Ht. 4-8' Sp. 5-8'	Upright Rounded	M	X	SU - Dark Green FA - Red	.Sun .Moist, well-drained soil
Weigela, Old Fashioned	Ht. 6-9' Sp. 6-15'	Rounded	C	X	Su - Medium Green FA - Yellow to Green	.Sun .Tolerant of most soils but prefers moist soil
Yucca, Adamsneedle	Ht. 3' Sp. 3-4'	Stiffly Upright	C	X	Medium Green (Evergreen)	.Sun .Tolerates most soils

INFORMATION SHEET

CONIFERS FOR DESIGN

Conifer Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Leaf Color SU-Summer FA-Fall W-Winter	Culture
Arborvitae, Techny Eastern	Ht. 8-10' Sp. 5-6'	Pyramidal	MF	Dark Green (Evergreen)	.Sun or shade .Prefers moist soil
BaldCypress, Common	Ht. 30-50' Sp. 15-30'	Pyramidal	F	SU - Medium Green FA - Yellow to Brown (Deciduous)	.Sun .Moist, well-drained soil
Douglas-Fir	Ht. 40-80' Sp. 12-20'	Pyramidal	M	Blue-Green Dark-Green (Evergreen)	.Sun .Prefers moist acid soil
Fir, Balsam	Ht. 45-75' Sp. 20-30'	Pyramidal	M	Glossy Dark Green (Evergreen)	.Sun .Moist, well-drained soil
Fir, White	Ht. 30-50' Sp. 15-30'	Pyramidal	M-MC	Blue-Green (Evergreen)	.Sun .Moist, well-drained soil
Hemlock, Canadian	Ht. 40-50' Sp. 20-35'	Pyramidal	F	Glossy Dark Green (Evergreen)	.Partial shade to shade .Prefers acid, moist, well drained soil
Larch, European	Ht. 70-75' Sp. 25-30'	Pyramidal	MF	SU - Deep Green FA - Vivid Yellow (Deciduous)	.Sun .Moist well-drained soil
Juniper, Andorra Creeping	Ht. 2' Sp. 10'	Low Growing	F	SU - Grey-Green W - Purplish (Evergreen)	.Sun .Withstands dry conditions

Conifer Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Leaf Color SU-Summer FA-Fall W-Winter	Culture
Juniper, Blue Rug Creeping	Ht. 6-8' Sp. 6-8'	Prostrate	F	Blue (Evergreen)	.Sun or partial shade .Withstands dry conditions
Juniper, Pfitzer Chinese	Ht. 8-10' Sp. 8-10'	Broad Spreading	F	Blue-green (evergreen)	.Sun .Withstands dry conditions
Pine, Austrian	Ht. 50-60' Sp. 20-40'	Pyramidal Flat-topped with age	MC	Dark Green (Evergreen)	.Sun .Very tolerant of most soils
Pine, Dwarf Mugo	Ht. 4-8' Sp. 12-20'	Rounded	M	Bright medium green (Evergreen)	.Sun or partial shade .Prefers moist soil
Pine, Eastern White	Ht. 50-80' Sp. 20-40'	Pyramidal Flat-topped with age	F	Dark Blue Green (Evergreen)	.Sun or partial shade .Prefers moist, well-drained soil
Pine, Limber	Ht. 30-50' Sp. 15-35'	Pyramidal	M	Dark Blue Green (Evergreen)	.Sun or partial shade .Prefers moist well-drained soil
Spruce, Blue Colorado	Ht. 80-100' Sp. 20-30'	Pyramidal	M	Blue-Green (Evergreen)	.Sun .Prefers rich, moist soil
Spruce, Norway	Ht. 40-60' Sp. 25-30'	Pyramidal	M	Dark Green (Evergreen)	.Sun or shade .Any good soil
Yew, Dense	Ht. 5' Sp. 5'	Spreading	M	Black-Green (Evergreen)	.Shade .Tolerant of most soils
Yew, Hicks	Ht. 8-10' Sp. 5-8'	Columnar	M	Black-Green (Evergreen)	.Shade .Tolerant of most soils

INFORMATION SHEET

GROUND COVERS FOR DESIGN

Ground Cover Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Barren-Strawberry	Ht. 6-12" Sp. 12"	Fast	M-C	X	Medium Green (Evergreen)	.Sun or shade .Tolerant of most soils
Bugle, Carpet	Ht. 6" Sp. 8-12"	Fast	C	X	Varied (Semievergreen)	.Sun or shade .Moderately moist
Cotoneaster, Creeping	Ht. 12" Sp. 18-24"	Slow	F		SU - Dark Green FA - Deep Red	.Sun .Well-drained soil
Daylilies	Ht. 2' Sp. 18-24"	Fast	M-F	X	SU - Green FA - Brown	.Sun or shade .Soil tolerant
Euonymus, Baby Wintercreeper	Ht. 2-6" Sp. 12"	Slow	F		Dark Green (Evergreen)	.Partial shade
Eunymus, Purpleleaf Wintercreeper	Ht. 6-18" Sp. 15-18"	Slow	M-F		SU - Dark Green FA - Purplish Red (Evergreen)	.Sun or shade .Tolerant of most soils
Forsythia, Bronx	Ht. 2' Sp. 2-4'	Medium	M	X	SU - Green FA - Green-Yellow	.Sun .Tolerant of most soils
Goutweed, Variegated	Ht. 8' Sp. 18'	Fast	M		SU - Light Green & White FA - Not Effective	.Sun or shade .Tolerates poor soil
Hosta	Ht. 12-24" Sp. 18"	Medium	C	X	Varied	.Shade .Tolerant but prefers moist soil
Ivy, English	Ht. 6" Sp. 6-12"	Fast	M		Dark Green (Evergreen)	.Sun or shade .Tolerant of most soils

Ground Cover Name	Size Ht.-Height Sp.-Spread	Growth Habit	Texture	Ornamental Flowers	Leaf Color SU-Summer FA-Fall	Culture
Lily-of-the-Valley	Ht. 8" Sp. 6"	Fast	MC	X	SU - Med. Green FA - Brown	.Shade .Moist soil
Lilyturf	Ht. 8-10" Sp. 12"	Fast	F	X	(Evergreen)	.Sun or partial shade .Tolerant of most soils
Periwinkle	Ht. 3-6" Sp. 12"	Medium-Slow	M	X	Dark Green Glossy (Evergreen)	.Sun or shade .Tolerates poor soil
Sedum, Dragon's Blood	Ht. 6-8" Sp. 12"	Medium	F	X	(Semievergreen)	.Sun .Tolerates poor soil
Spurge, Japanese	Ht. 6-12" Sp. 12"	Slow to Medium	M	X	Light Green (Evergreen)	.Shade or partial shade .Prefers moist, well drained, acid soil

INFORMATION SHEET

ESTABLISHING LANDSCAPE NEEDS

Every home deserves the most attractive setting that can be provided. Unfortunately, many homes are over-landscaped or not landscaped at all. It is common to see homes hidden by a forest of plantings or surrounded by an unrelated collection of trees and shrubs. This demonstrates a lack of planning.

Landscaping is more than planting trees and shrubs. It means creating a plan in order to make the best use of the space available in the most attractive way. This involves shaping the land to make the most of the site's natural advantages. It also means building structures such as fences, walls, and patios and selecting and growing the plants which best fit into the design.

A successful landscape plan involves three considerations:

1. Consider the lot to be like a room. The ground is the floor, the property lines are walls, and the ceiling is the sky and canopies of trees.
2. Consider the floor plan of the home in order to form a relationship between the indoors and outdoors.
3. Consider the design of the landscape as viewed by those on the outside.

The final landscape plan should depend on the lot and its orientation to wind and sun, the house plan, the amount of money, time and effort to be spent on maintenance, family interests, and the neighborhood.

Study the views from the house. Those which are good should be framed, while those that are bad, screened. For example, designs for homes adjacent to golf courses or parks should utilize the extra lawn to give a sense of space to the property.

Sunshine, rain, snow, wind, heat and cold will influence the landscape design. Protection from summer sun and heat, and winter winds and snow must be considered. Proper slope of land is necessary to carry excess water away from the home.

Soil type effects the choice of plants for the design. It is much easier to select plants which do well in a particular type of soil than to try to change the soil for the benefit of plants. The drainage of the soil and the pH should be noted before selecting plants.

The family needs are probably the most important considerations in designing. An inventory of family needs will help to determine which elements will make the landscape most livable, useful and attractive. Remember, each family's needs are different.

INFORMATION SHEET

STARTING A PLAN

Planning the design on paper is extremely helpful. The more accurate the plan, the more useful it will be. Begin by carefully measuring the location of all the physical objects on site, such as trees, walks, drives, etc. Record the measurements as they are made; then, transfer the measurements to graph paper. The preferred scale is 1/8 inch. Indicate the location of windows and doors to scale. Also indicate the location of any easements. This will serve as the base plan.

Good landscape designs are planned with three major areas in mind: the public area, the living area, and the service area.

The public area lies between the road and the house. Four elements make up the public area (1) walks, drives and public areas (2) tree plantings (3) shrub plantings, and (4) lawn areas. The most important consideration in the public area is the front door. It should be the focal point for the design.

Walks greatly affect the appearance of the public area. The most desirable placement of a walk is parallel to the front of the house connecting the driveway and the porch.

Large expansive driveways detract from the house; hence, keep the width at a minimum - 10 feet for one car and 18 feet for two cars.

Trees make up a second element of design for the public area. Trees should be placed to frame the house, provide shade and mask undesirable architectural details. Always use a large tree to frame a two-story house. Select trees that will be branched high enough to allow view of the house. The most effective placement of trees to obtain a framing effect is decided by the view of the home from 30 to 45 degree angles from the street. Passersby do not view homes at sharp right angles.

Shrub plantings make up the third public area design element. These plantings should complement the architecture of the house and tie the house to the surrounding area.

The other element of design is the lawn. The lawn serves to connect all the other elements and gives a broad expansive setting to the house. A lawn unbroken by walks provides best results.

It should be noted here that island flower beds, gazing balls, fountains, pink flamingos, tractor tires and other novelties have no place in the public area. These novelties break the cardinal rule that the house is the most important feature of the design by diverting attention.

The outdoor living area includes all the property to the rear of the house, except for the service area. It usually includes a patio located near a door.

Many design elements can be selected to meet a family's needs and interests. Some of those follow:

1. Enclosures (fences, walls, and screen plantings).
2. Plantings (shrubs, hedges, flowers, and ground covers and trees).
3. Surfaced areas (patios, paths, sitting areas).
4. Garden embellishments (sculptures, garden furniture, planters, rocks, lighting).

The enclosures form the sides of the outside room, define space, and give organization to the open expanses of land.

The plants provide a pleasing, refreshing, soul-satisfying setting around the home.

Basic surfacing types are (1) paving for heavy traffic, (2) lawn for medium traffic, (3) woodchips, sand and gravel for little used areas, (4) ground covers where no one is to walk, and (5) flower beds and shrub beds.

Garden embellishments are similar to home furnishings and accessories.

The Service Area is set aside for the locating of garbage cans, clotheslines, compost piles, vegetable gardens and other items. In most cases, the service area is screened from the outdoor living area.

Before any designing is done, it is necessary to determine the needs and interests of the family. This can be accomplished by interviewing the family or by having them complete a family inventory checklist. The checklist should provide information about the family, it's gardening interests, and it's entertainment interests. Favorite plants of the family and desired landscape structures should be included.

INFORMATION SHEET

ANALYZING THE SITE

The most common site conditions to be considered include topography, drainage, soil, existing vegetation, natural features, climate, structures, walks and drives, and the extensional landscape.

Always try to make the best use of the topography that exists on the site and try to preserve the natural features of the land. Also, think of the property as a unit of land and not as an "island" unrelated to the surrounding areas.

Drainage is almost always altered during the course of house construction. Look for the areas in which water collects and stands for long periods. Make certain that water does not flow towards the house or building. A 2% slope away from buildings is recommended.

Soil is important in that it is the growing media for the plants. Determine if fertilizers or amendments are needed.

Existing vegetation should be evaluated to determine its use in the design. The quality, quantity, kind of material (tree or shrub), and genus and species should be considered.

Natural features are the earth, rock and water on the site. Try to incorporate these natural materials into the plan with the least amount of modifications.

Climate is the general expression of temperature, precipitation, humidity, and wind. The factors should be considered for both human comfort and the growing of plants.

In addition to on-site observations, check local zoning and subdivision ordinances for location and height restrictions for fences, walls, plantings, and structures on the property.

Record on-site observations on a sheet of tracing paper placed over the base plan. This new drawing is called the site survey sheet.

Information collected through on-site observations can be used for "Goose egg" planning. Place an overlay sheet over the site survey sheet and the base plan. Sketch the approximate locations in which various activity areas (patio, service area, play area, etc.) will take place.

INFORMATION SHEET

SELECTING PLANTS TO FIT YOUR DESIGN

One of the major building materials in a landscape design is plants. Simply planting shrubs here and there is not good design. Good design requires an understanding of each plant's environmental needs and individual qualities. Form, texture, and color are important considerations in selecting plants.

Each plant prefers certain conditions for best growth. Therefore, plants should be selected by their ability to do well in particular situations.

Form is the first design quality of plants to consider. It is the outline of the plant as well as the three dimensional mass of the plant. Examples are columnar, round, vase, weeping, pyramidal and oval. The more extreme the form, the more attention it attracts; however to hold attention, color and texture must be considered.

Ascending forms, such as evergreens, give accent to the design. Horizontal and spreading forms emphasize the breadth of space. Rounded forms are the most common and lend themselves well to group and mass compositions.

Using plants of one form can be monotonous. Use different shapes to provide variety and interest.

Texture is the second design quality of plants to consider. Basically, texture is a plant's qualities of coarseness or fineness, roughness or smoothness, heaviness or lightness, thinness or denseness. Coarse textured plants tend to move toward the viewer, while fine textured plants tend to recede. Monotony results when all the plants in a design have similar texture. Use some variation to add interest, but avoid extremes. Never place the finest textured plant next to the coarsest. Also avoid placing coarse plants in small areas as they will make the space appear even smaller.

Color is the third design quality of plants. This element has the greatest appeal and summons the greatest response.

Colors can be divided into two groups - warm colors and cool colors. Warm colors include yellow, orange, and red. Cool colors are green, blue, and violet. Warm colors are striking, cheerful and stimulating, while cool colors are restful. In design, warm colors tend to advance or appear closer, and cool colors appear more distant.

The main purpose of plants in the landscape is to provide a leafy, green setting that creates an atomosphere of restfulness. To achieve this, green foliage plants should outnumber the bright colored foliage plants by at least 9 to 1.

In addition, foliage color should be in harmony with the color of the house or building. Do not select colors that are going to clash.

"Principles of Design"

A unified planting composition may be created by manipulating form, texture, and color. Unity can be accomplished by applying the design principles of simplicity, variety, balance, emphasis, sequence, and scale. (R. V. Bess)

What is unity? Unity is the quality of oneness. The aim is to attract and hold attention, to help the viewer "grasp" the design, and to organize the various parts.

Repetition:	(Simplicity) Line, form, texture and color uniformly repeated or with some variations can produce unity.
Variety:	(Contrast) Variations and contrast in line, form, texture, and color will focus attention and add interest to the design.
Balance:	(Symmetry, opposition, alteration) Implies equilibrium whether it be formal or informal. Formal balance gives a sense of stability and informal balance has a dynamic quality.
Emphasis:	(Dominance) Means dominance of certain elements and the subordination of others.
Sequence:	(Uniformity of change) Change of at least one quality of line, form, texture, or color gives transition from one line to another, from one area to another, or from one mass to another.
Scale:	(Proportion) Absolute scale refers to the size of an object with relation to a designated standard such as a building or human body. Relative scale refers to the size of one object in relation to the other objects in a given composition.

INFORMATION SHEET

FITTING TREES TO YOUR PLAN

The proper selection of trees for a landscape is important because they are the most permanent of all plant materials.

When selecting a tree, decide on the functions it will serve. Trees may provide shade, frame views, mask awkward architectural features, and provide a backdrop for the home. Trees also establish the scale of the landscape. A well-placed tree can shade a play area, frame an off-property view, and serve as a backdrop for the house.

The spacing of trees must allow for the mature spread if they are to be specimens. They may be placed closer if a group effect is desired. Do not use more than two or three different species of trees to compose each planting group.

Other considerations are:

1. Select trees that are hardy.
2. Do not use trees that drop messy fruit or twigs.
3. Avoid selecting trees that have root systems located at the surface.
4. Do not select rapid growing trees as they are short-lived and subject to storm damage.
5. When upright evergreens are used, they should be grouped in clumps of three of four.
6. Keep trees away from power lines and telephone wires.

INFORMATION SHEET

FITTING SHRUBS TO YOUR PLAN

Shrubs should be selected for their flowers, foliage, branching habits, and suitability for a specific location. There are a great number of shrubs from which to choose, so consider the line, form, color and texture of each.

Shrubs can be used as specimens, accent plants, group plantings, shrub borders, hedges, screens, and foundation plantings.

Specimen: In most cases a specimen plant is a perfect example of a particular shrub in that it displays outstanding form, texture, color or a combination of these elements. Though not the same as border plants, specimens should share size, shape, foliage, texture, or color characteristics with the group planting.

Accent Plants: Where specimen plants stand alone, accent plants are part of a shrub mass. Accent plants may also differ in form, color, and texture from the shrub mass.

Group Plantings: Shrubs in a group planting have less individuality than specimen plants, since three to five different species are used to make a composition. The value of the group planting is derived from the height, form, and arrangement of the individual plants.

Shrub Borders: A mass planting of shrubs on a border helps to create an outdoor living room, provides a backdrop for flowers, and screens views.

Four major steps aid in designing a shrub border:

Step 1. Sketch a series of blocks or rectangles representing various sizes of plant material desired. A scale of 1/8"=1'0" is probably the most practical.

Step 2. Place the abstract composition at the top of a sheet of tracing paper. Below sketch the growth habits of plants to replace the blocks.

Step 3. Next, indicate the texture and color of each mass. Begin with textures (C = Coarse, MC = Medium-coarse, M = Medium, MF = Medium-fine, F = Fine). Foliage colors may be G (Emerald Green), BLG (Blue-green), YG (Yellow-Green), RG (Red-Green), GG (Gray-Green) and BG (Black-Green).

Step 4. This step should be easy in that it requires the selection of plants and the placing of the plants in plain view.

Hedges: Hedges can be formal (clipped) or informal (unclipped). Hedges may define space, tie the various planting units together and screen views.

Screens: A solid mass of one plant type will give the effect of a living wall. The ideal growth habit of a screen plant is tall and narrow and with foliage to the ground.

Foundation Plantings: These are shrubs placed around the house to achieve a natural appearance. The best shrubs for foundation planting are those which do not get very large.

INFORMATION SHEET

DESIGNING THE PUBLIC AREA

The public area, if properly designed, greatly enhances the appearance and market value of the property. The most prominent feature of the public area is the house. Therefore, the design should be dictated by the architecture of the home.

Basic design principles for developing the public area include:

1. Softening the architectural lines of the home
2. Framing the home with trees
3. Maintaining open lawn areas

Blending the structure of the house with the general surroundings should be the main purpose. Plantings at the outside corners of the house will accomplish this. Another important planting arrangement is located on each side of the door.

Plantings on either side of the door may be identical if the house has a formal balance. Homes with asymmetrical balance should have different plantings on either side of the doorway. To determine the height of the plantings draw a line from the threshold of the door to a point two-thirds of the distance from the ground to the eave at the corners. The doorway plants should not be taller than the line.

In most cases, the plants on the corners should not be higher than two-thirds the distance from the ground to the eave. Doorway plants are usually no taller than one-fourth to one-third the distance from the ground to the eave. Taller plants at the corners and shorter ones at the doorway create a concave line which directs attention to the door.

Before selecting special plants and placing them in front of a house, study the architectural lines and masses of the house. Draw a rough sketch to scale of the front of the house. Properly locate the windows, doors, and porches on the drawing. Indicate the dominant lines with colored pencils. Then, determine the balance of the home and how proper placement of planting masses can achieve better balance.

Select trees and shrubs that are going to repeat the dominant lines of the house. For instance, use trees with horizontal branching with houses that have distinct horizontal lines. Houses with dominant pyramidal forms call for trees with pyramid growth habits. Only houses with pyramidal forms should have pyramidal plants in the public area.

Now it is necessary to consider the masses of the home. On the sketch of the home, note the dominant masses with colored pencils. The planting design should repeat the architectural masses at the end of the house opposite to the end which the mass is located. This reversal of location provides a pleasing counterplay of masses. In designing masses, use the process of designing a shrub border as mentioned in the Information Sheet "Fitting Shrubs to Your Plan."

Finally, study the architectural details of the home. Different sized windows, randomly located shutters, wrought-iron railings, roof supports, changes in building materials, and changes in color lead to a "busy" appearance. When these are present, design simple plantings neutral in color and form to avoid further visual confusion. Houses with windows of equal size and evenly spaced or with little detailing permit more variety in the landscape plantings.

Foundation plants should not get so large as to cover the windows. Consider their mature size when designing, and show their mature size on the plans. If the house has a wide overhang, place the plant material one foot beyond the drip line.

The shrub plantings should not be placed in the lawn. They should be placed in cultivated beds. The outline of the bed may be curved, straight or arc and tangent lines. To be effective, curved lines must be bold. Wiggly lines are "busy" in appearance, thus distracting to the overall plan. Straight line bed patterns are desirable because they complement the architectural lines of the house. The straight line pattern may consist of lines drawn at 90 degrees to the house and parallel to the house or lines set at 45 degrees to the house. Arc-and-tangent lines are an effective compromise between the curved and straight lines.

Whichever style is used, start and finish the planting beds at architectural features of the house. Some examples are: The edge of a window, a jog in the wall, a change of building material, etc. On wall surfaces devoid of architectural features, begin the bed one-third or two-thirds the distance across the wall.

An open lawn is another principle of public-area design. A broad, expansive uncluttered lawn provides the best setting for a home.

INFORMATION SHEET

DESIGNING THE LIVING AREA

The living area is the area located behind the house. It should be designed for both utility and beauty. Of course, how the area is developed depends upon the family's interest in gardening, outdoor living and other activities.

Review the family inventory, the site analysis and goose egg plans to determine the types of spaces needed for various activities. General living spaces include the patio, outdoor court and children play areas; while work spaces might include vegetable gardens, storage and the service area.

Begin the design of the living area by developing the ground pattern. On a piece of scratch paper, sketch the shape of the lot. It should be no larger than three or four inches and it should be proportional to the dimensions on the base plan. Now sketch several possible bed patterns on tracing paper laid over the initial sketch. Use the goose egg study as a guide.

Select the best sketch and transfer the lines to tracing paper placed over the base plan. Some adjustments to the pattern may have to be made to permit the desired activities.

Now, locate the trees on the plan. Well-placed trees may offer shade and overhead protection and serve as a backdrop for the house.

Decide where vertical elements such as walls, fences, and upright narrow plant material should be placed. The function of these elements include organizing space, screening views and providing privacy.

Next, select and arrange plants to strengthen the pattern design and to refine spaces being created. Use the technique described in the Information Sheet "Fitting Shrubs to Your Plan" to locate the shrubs and flowers. Try to make each view as attractive as possible.

The outdoor living area also requires different surfacing materials for the different activities. The most common and functional surface is a lawn. Lawns are attractive, good for play, and walking or lounging on them is pleasant. Other common surfaces are ground covers, paving and loose aggregate.

Patios are another important element in today's landscapes. They are an extension of the indoors, and they automatically become a good vantage point from which to view the yard. In fact, the yard should be designed to provide an attractive view from the patio. Also, the line of the patio should be reflected in the rest of the design. The minimum size of a patio is 15' by 20' or 300 square feet, and the recommended size is 400 square feet.

Finally, don't worry about a design not being perfect. The best design for a home is one which is attractive, satisfying and functional for the family. This can be accomplished in many different ways.

STUDENT WORKSHEET

ESTABLISHING LANDSCAPE NEEDS, STARTING A PLAN, ANALYZING THE SITE

1. What are three considerations required in every successful landscape design?

   1.

   2.

   3.

2. What is a landscaping?

3. Name the three major areas that are designed.

   1.

   2.

   3.

4. List four elements which make up the public area.

5. What are three function of trees placed in the public area?

   1.

   2.

   3.

6. List two major benefits from having a large unbroken lawn.

7. Why are gazing balls, pink flamingos and other novelties located in the public area considered poor design?

8. Where is the outdoor living area located?

9. List four elements of design which help meet family needs and interests. Give example of each.

   1.

   2.

   3.

   4.

10. Give 3 examples of functions in the service area.

    1.

    2.

    3.

11. What is a site survey sheet?

12. What observations are noted on a site survey sheet?

13. What is "goose egg" planning, and why is it an important step in design?

STUDENT WORKSHEET

SELECTING PLANTS TO FIT YOUR DESIGN, FITTING TREES TO YOUR PLAN, FITTING SHRUBS TO YOUR PLAN

1. What are three important considerations in selecting plants for the landscape?

2. How do the functions of round plant forms and upright plant forms differ?

3. How can the texture of a plant affect the design?

4. How do warm and cool colors differ in appearance?

5. Unity of a composition can be achieved by applying the design principles of R. V. Bess. Briefly explain the importance of each.

   Repetition:

   Variety:

   Balance:

   Emphasis:

   Sequence:

   Scale:

6. List five important factors when selecting trees for the landscape.

7. What is a:

Specimen -

Accent Plant -

Group Planting -

Shrub Border -

Hedge -

Screen -

Foundation Planting -

8. What are the steps in designing a shrub border? Explain each step.

STUDENT WORKSHEET

DESIGNING THE PUBLIC AREA, DESIGNING THE LIVING AREA

1. Basic design principles for developing the public area include:

   1.

   2.

   3.

2. What are two major plantings in the public area?

3. The growth habits of plants should reflect or repeat ________________.

4. Shrubs should be placed in cultivated beds. The outline of the beds may be ______________, __________________, or _________________.

5. Where should bed lines begin or end?

6. What functions do walls, fences, and upright narrow plants serve?

7. What is the minimum desirable size for a patio?

TEACHER'S KEY

STUDENT WORKSHEET

ESTABLISHING LANDSCAPE NEEDS, STARTING A PLAN, ANALYZING THE SITE

1. What are three considerations required in every successful landscape design?

    1. Consider the lot to be like a room.

    2. Consider the floor plan of the home.

    3. Consider the landscape as viewed by those on the outside.

2. What is a landscaping?
   Landscaping is creating a plan to best utilize available space in the most attractive way. This involves shaping the land to make the most of the site's natural features, building structures, and selecting and growing plants which best fit into the design.

3. Name the three major areas that are designed.

    1. The public area

    2. The outdoor living area

    3. The service area

4. List four elements which make up the public area.
   Walks; public areas; drives; trees; shrubs; lawn areas.

5. What are three function of trees placed in the public area?

    1. Frame the house.

    2. Screen architectural details.

    3. Provide shade.

6. List two major benefits from having a large unbroken lawn.
   It connects all other elements.
   It gives a broad expansive setting for the house.

7. Why are gazing balls, pink flamingos and other novelties located in the public area considered poor design?
   They detract from the house.

8. Where is the outdoor living area located?
   In the rear of the house with the exception of the service area.

9. List four elements of design which help meet family needs and interests. Give example of each.
    1. Enclosures (fences, walls, screens)
    2. Plantings (trees, shrubs, hedges)
    3. Surfaced areas (walks, patios, drive)
    4. Garden embellishments (sculptures, planters, furniture)
10. Give 3 examples of functions in the service area.
    1. Garbage cans
    2. Clotheslines
    3. Compost piles
11. What is a site survey sheet?
    A record of on-site observations
12. What observations are noted on a site survey sheet?
    Drainage, soil conditions, existing vegetation, natural features, climatic conditions.
13. What is "goose egg" planning, and why is it an important step in design?
    'Goose egg' planning is making rough sketches of where various activities will occur in the landscape. These sketches will serve as a guide for designing bed patterns.

TEACHER'S KEY

STUDENT WORKSHEET

SELECTING PLANTS TO FIT YOUR DESIGN, FITTING TREES TO YOUR PLAN, FITTING SHRUBS TO YOUR PLAN

1. What are three important considerations in selecting plants for the landscape?

   Form, texture and color

2. How do the functions of round plant forms and upright plant forms differ?

   Upright forms attract attention, visually active.
   Round forms are subtle, pleasing to the eye.

3. How can the texture of a plant affect the design?

   Coarse textures attract attention and fine textures appear to recede.

4. How do warm and cool colors differ in appearance?

   Warm colors give the illusion of closeness and may make small areas appear smaller.
   Cool colors appear to recede.

5. Unity of a composition can be achieved by applying the design principles of R. V. Bess. Briefly explain the importance of each.

Repetition:	(Simplicity) Repetition of like forms, texture, and colors provide unity.
Variety:	(Contrast) Some variation in form, texture, or color will add interest to the design.
Balance:	(Symmetry, opposition, alternation) Implies equilibrium whether it can be formal, which gives a sense of stability, or informal which is dynamic.
Emphasis:	(Dominance) Some elements of a design need to have more visual energy than others.
Sequence:	(Uniformity of change) Uniform change of for texture or color provides a pleasant transition from one unit to another.
Scale:	(Proportion) Absolute scale: Relation of object to designated standard such as a person or a building.

6. List five important factors when selecting trees for the landscape.

   .Hardiness
   .Messiness
   .Growth Rate
   .Root growth
   .Mature tree size

7. What is a:

Specimen - Outstanding form, texture, and color - can stand alone

Accent Plant - Outstanding form, texture or color but part of shrub mass

Group Planting - Less individuality, 3-5 species

Shrub Border - Mass planting of shrubs on a border

Hedge - Formal or informal row of like plants

Screen - Tall, narrow, one type of plant

Foundation Planting - Plant materials located to hide a house foundation

8. What are the steps in designing a shrub border? Explain each step.

Four major steps aid in designing a shrub border:

Step 1. Sketch a series of blocks or rectangles representing various sizes of plant material desired. A scale of 1/8"=1'0" is probably the most practical.

Step 2. Place the abstract composition at the top of a sheet of tracing paper. Below sketch the growth habits of plants to replace the blocks.

Step 3. Next, indicate the texture and color of each mass. Begin with textures (C = Coarse, MC = Medium-coarse, M = Medium, MF = Medium-fine, F = Fine). Foliage colors may be G (Emerald Green), BLG (Blue-green), YG (Yellow-Green), RG (Red-Green), GG (Gray-Green) and BG (Black-green).

Step 4. This step should be easy in that it requires the selection of plants and the placing of the plants in plain view.

TEACHER'S KEY

STUDENT WORKSHEET

DESIGNING THE PUBLIC AREA, DESIGNING THE LIVING AREA

1 Basic design principles for developing the public area include:

   1. Softening the architectural lines of the home

   2. Framing the home with trees

   3. Maintaining open lawn areas

2. What are two major plantings in the public area?
   Corner plantings, doorway plantings

3. The growth habits of plants should reflect or repeat architectural lines.

4. Shrubs should be placed in cultivated beds. The outline of the beds may be curved, straight, or arc & tangent.

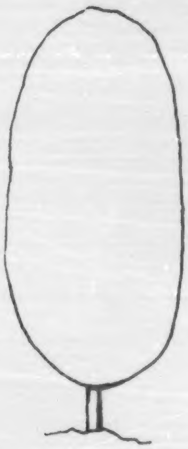
5. Where should bed lines begin or end?
   At architectural features of the house

6. What functions do walls, fences, and upright narrow plants serve?
   Organizing space, screening views, and providing privacy

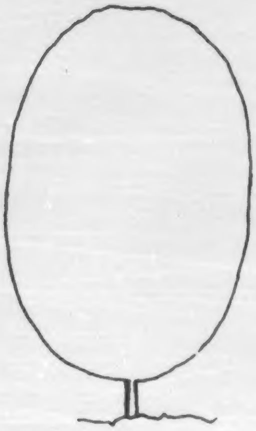
7. What is the minimum desirable size for a patio?
   300 sq. ft.

8. What is the recommended height of corner plants?
   Corner plants should be no taller than 2/3's the distance from the ground to the eave.

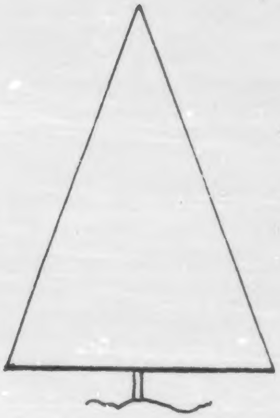
PLANT FORMS



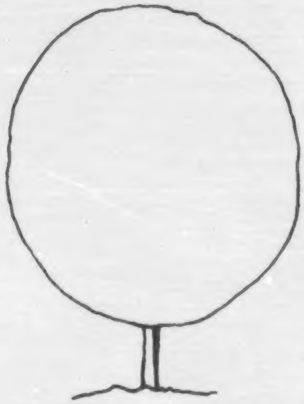
COLUMNAR-
English Oak



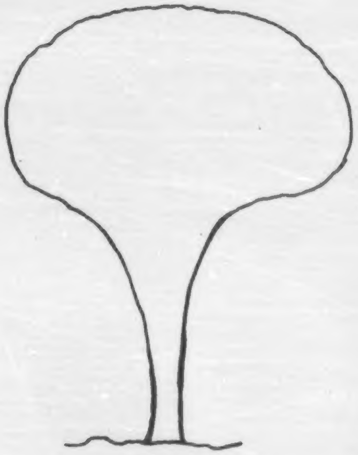
OVAL-
Sugar Maple



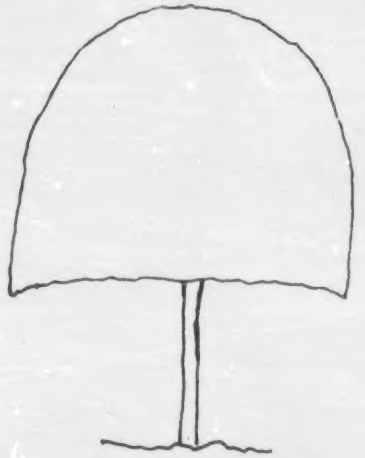
PYRAMIDAL-
White Fir



ROUND-
Norway Maple



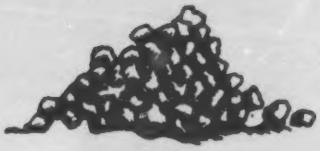
VASE-
Hackberry



WEEPING-
Weeping Willow

TEXTURE

TEXTURE IS :



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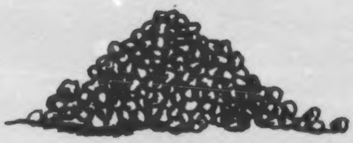
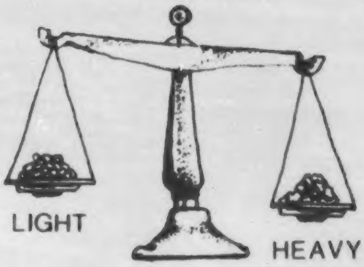
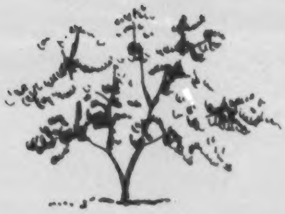
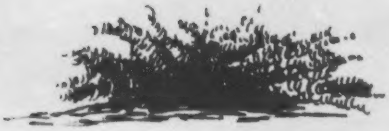


FINE

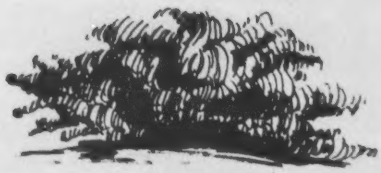

LIGHT
HEAVY



THIN



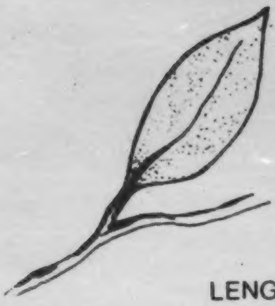
DENSE



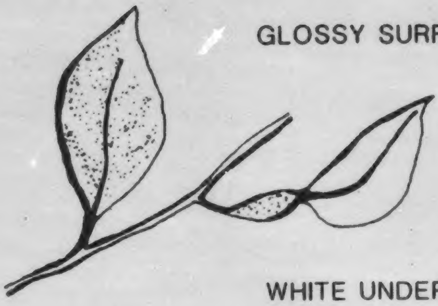
LIGHT AND SHADE

TEXTURE

TEXTURE RESULTS FROM:

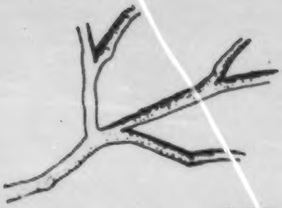


LENGTH OF PETIOLE

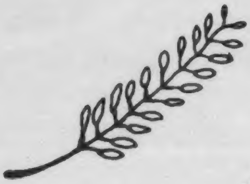


GLOSSY SURFACE

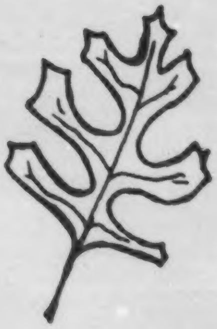
WHITE UNDERSIDE



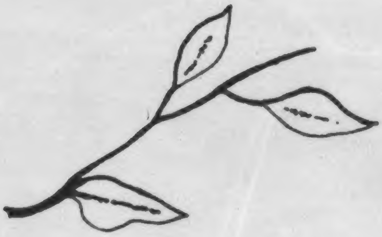
SIZE OF TWIG



SIZE OF LEAF



ENTIRE OR CUT LEAF



SPACING BETWEEN LEAVES

COLOR

WARM

These are cheerful, stimulating, and tend to advance.

YELLOW

ORANGE

RED

COOL

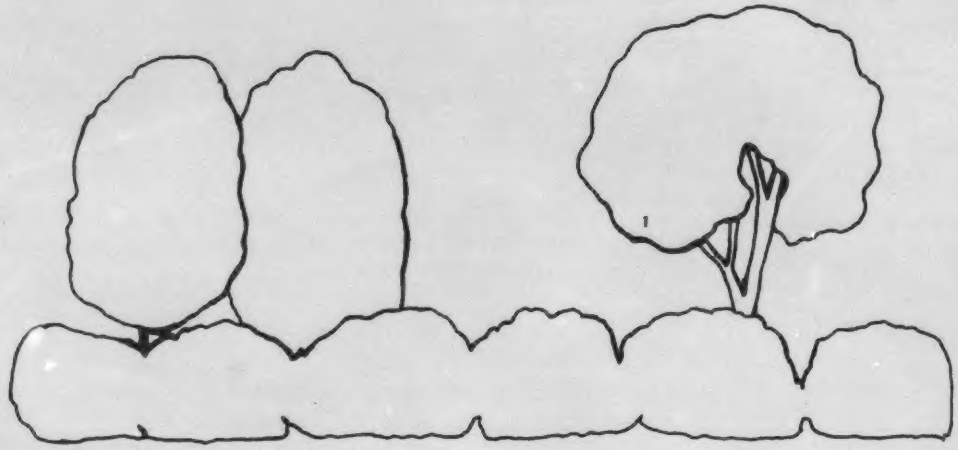
These are restful and recede or suggest distance.

GREEN

BLUE

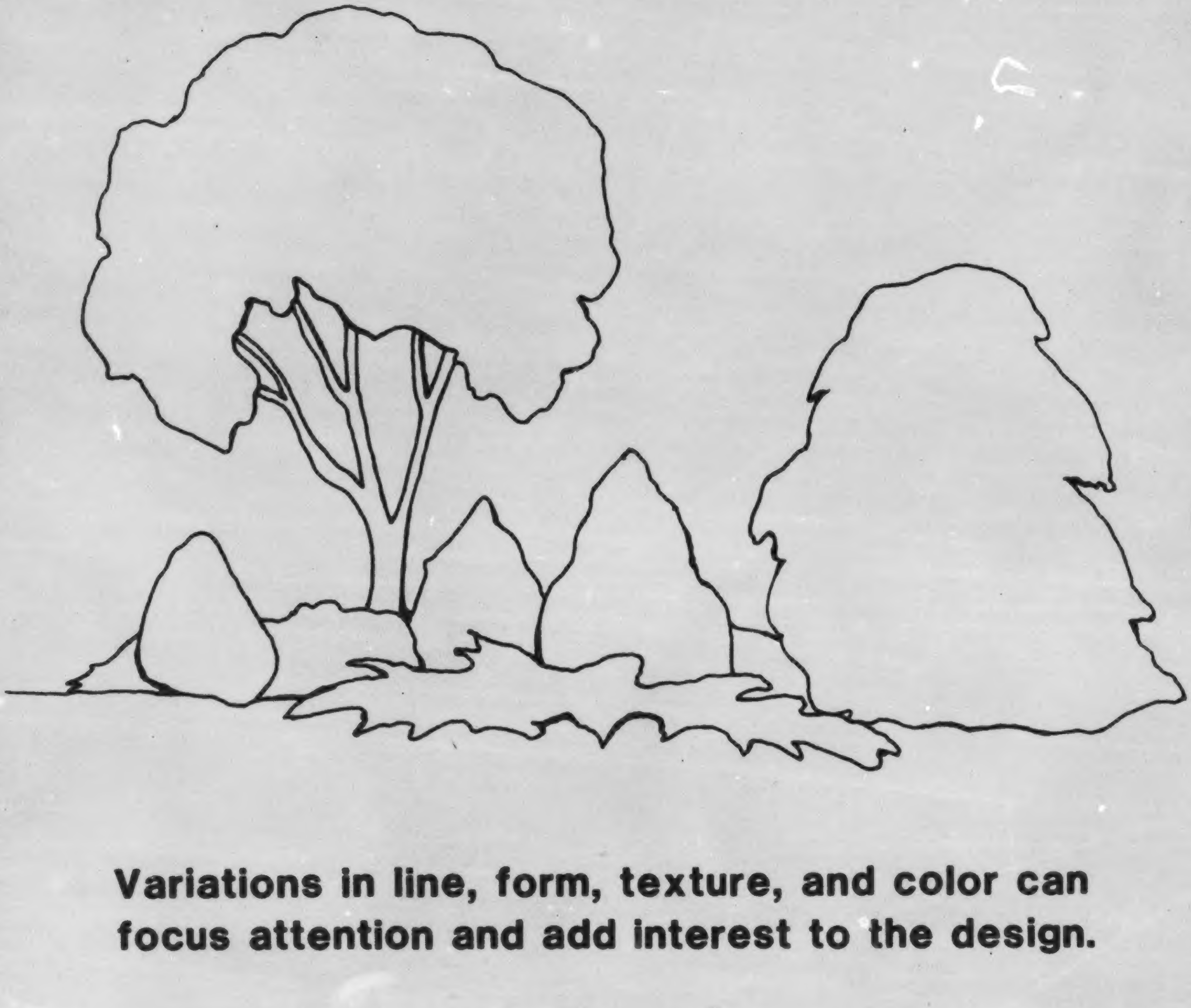
VIOLET

REPETITION



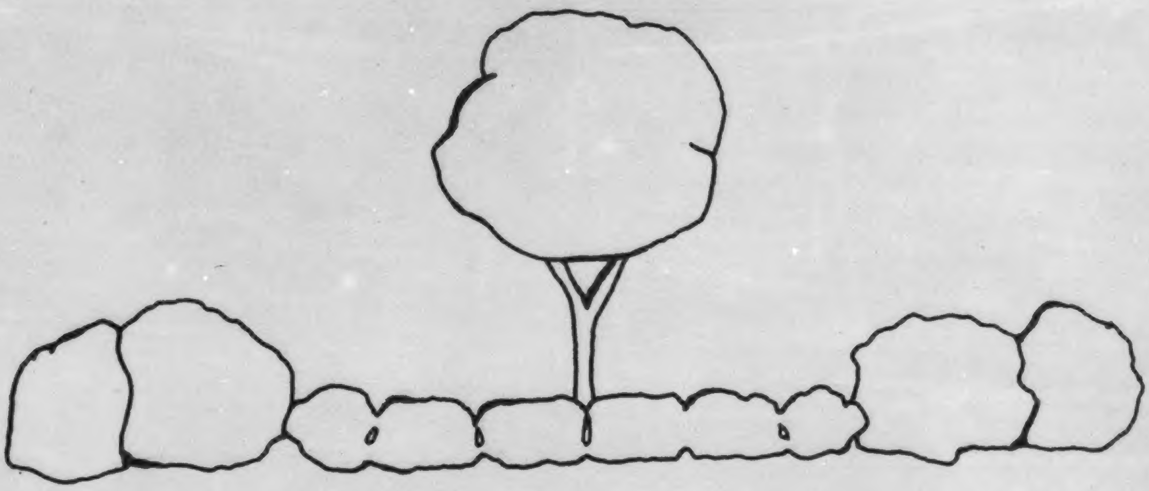
Line, form, texture and color uniformly repeated can produce unity.

VARIETY

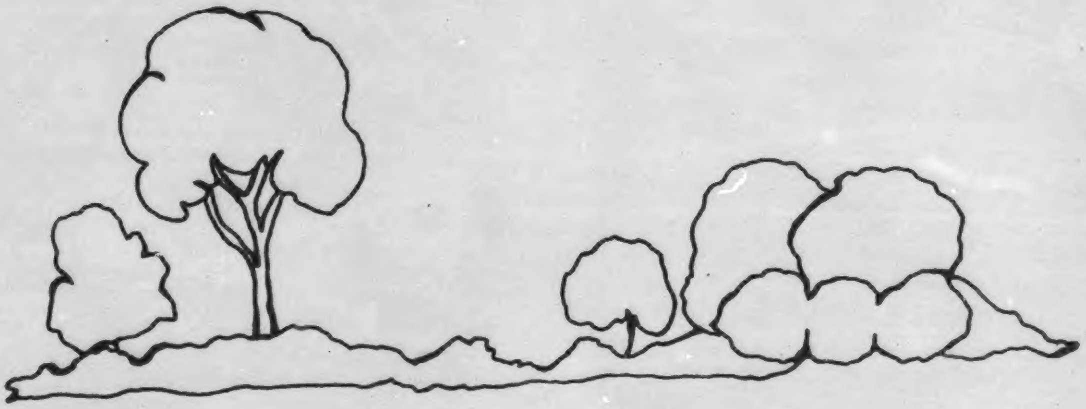


Variations in line, form, texture, and color can focus attention and add interest to the design.

BALANCE



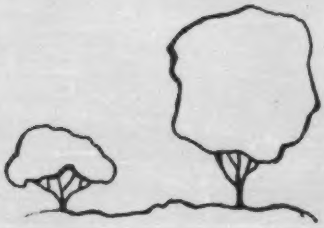
FORMAL - This gives a sense of stability.



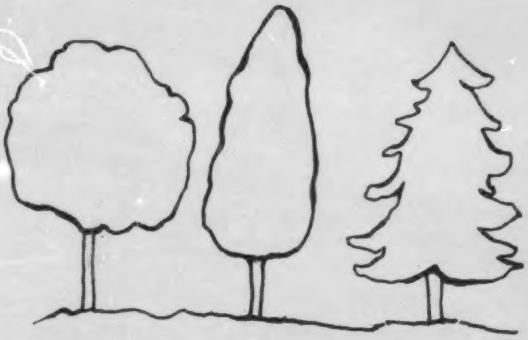
INFORMAL - This has a dynamic quality.

EMPHASIS

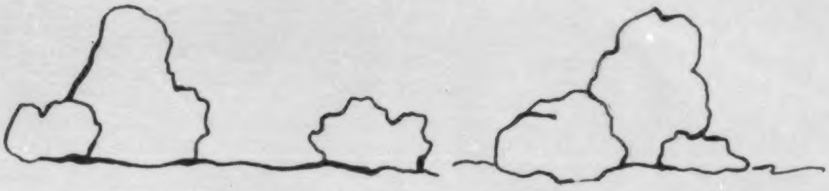
EMPHASIS CAN BE ACHIEVED THROUGH:



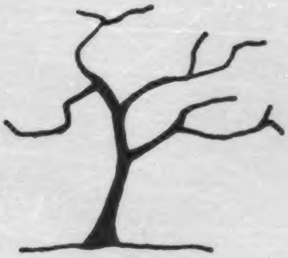
SIZE



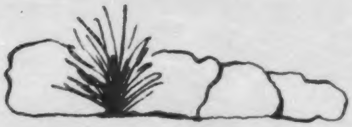
SHAPES



GROUPING

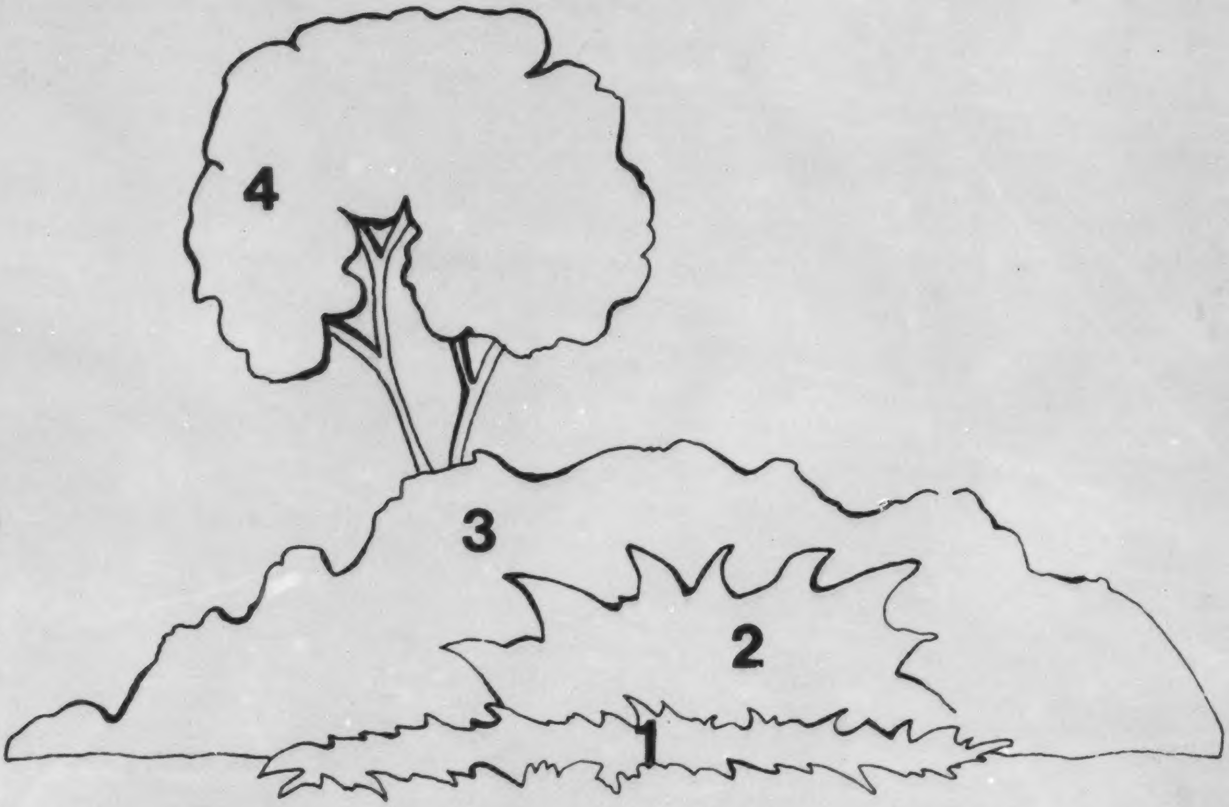


BOLD SHAPES



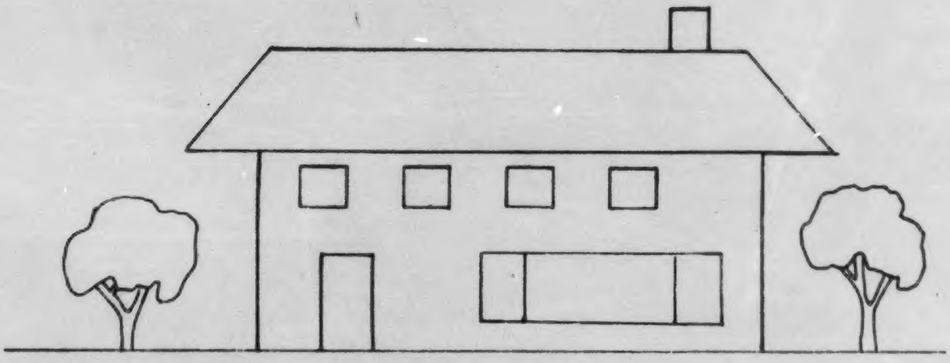
UNUSUAL PLANTS

SEQUENCE

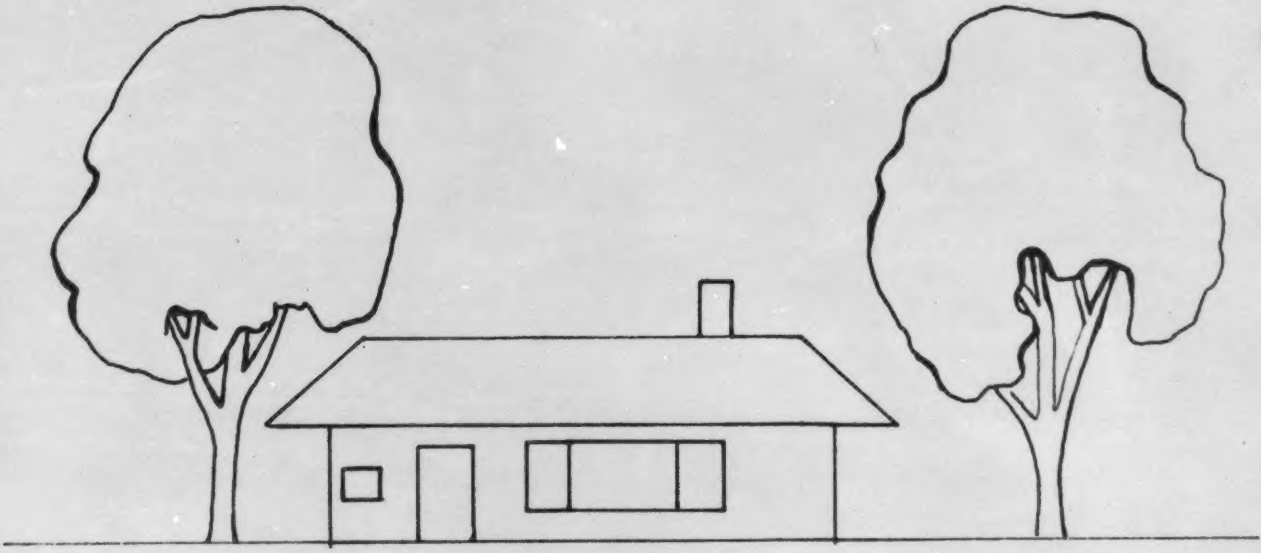


Change of at least one quality of line, form, texture or color gives transition from one item to another.

SCALE AND PROPORTION

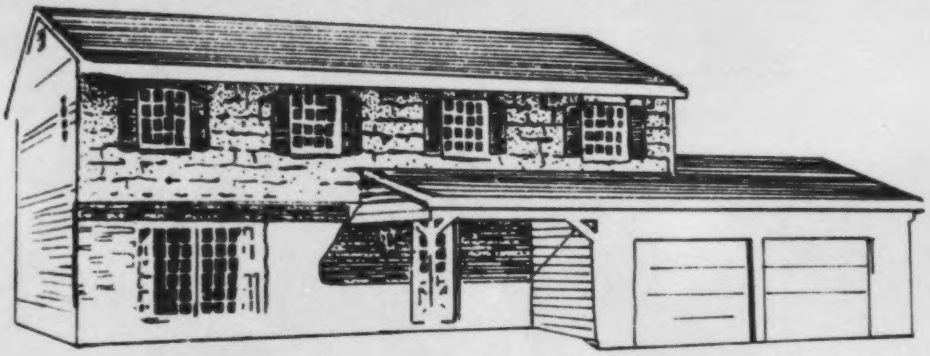


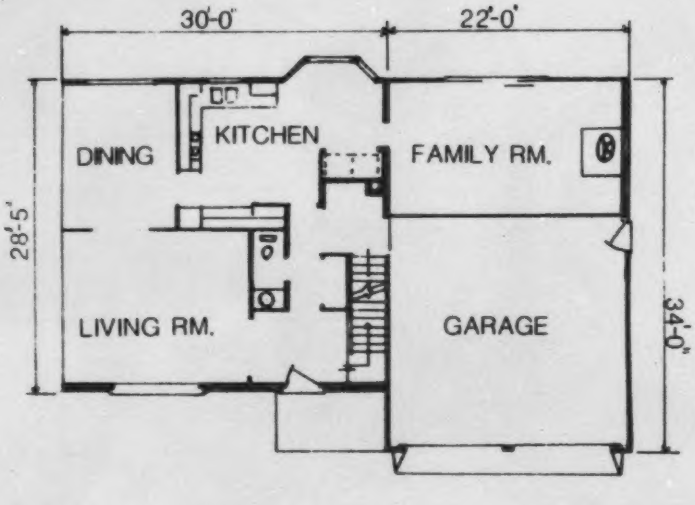
This house appears larger than it is.



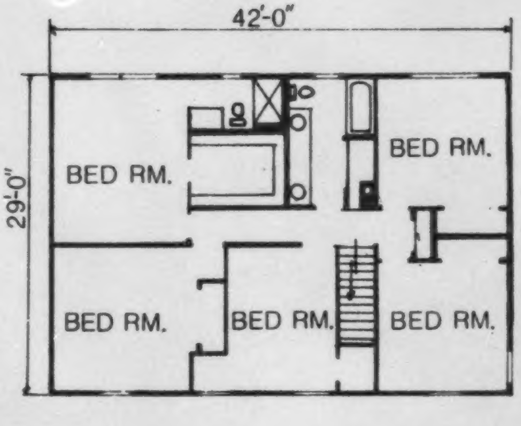
This house appears smaller than it is.

ELEVATION VIEW AND FLOOR PLAN



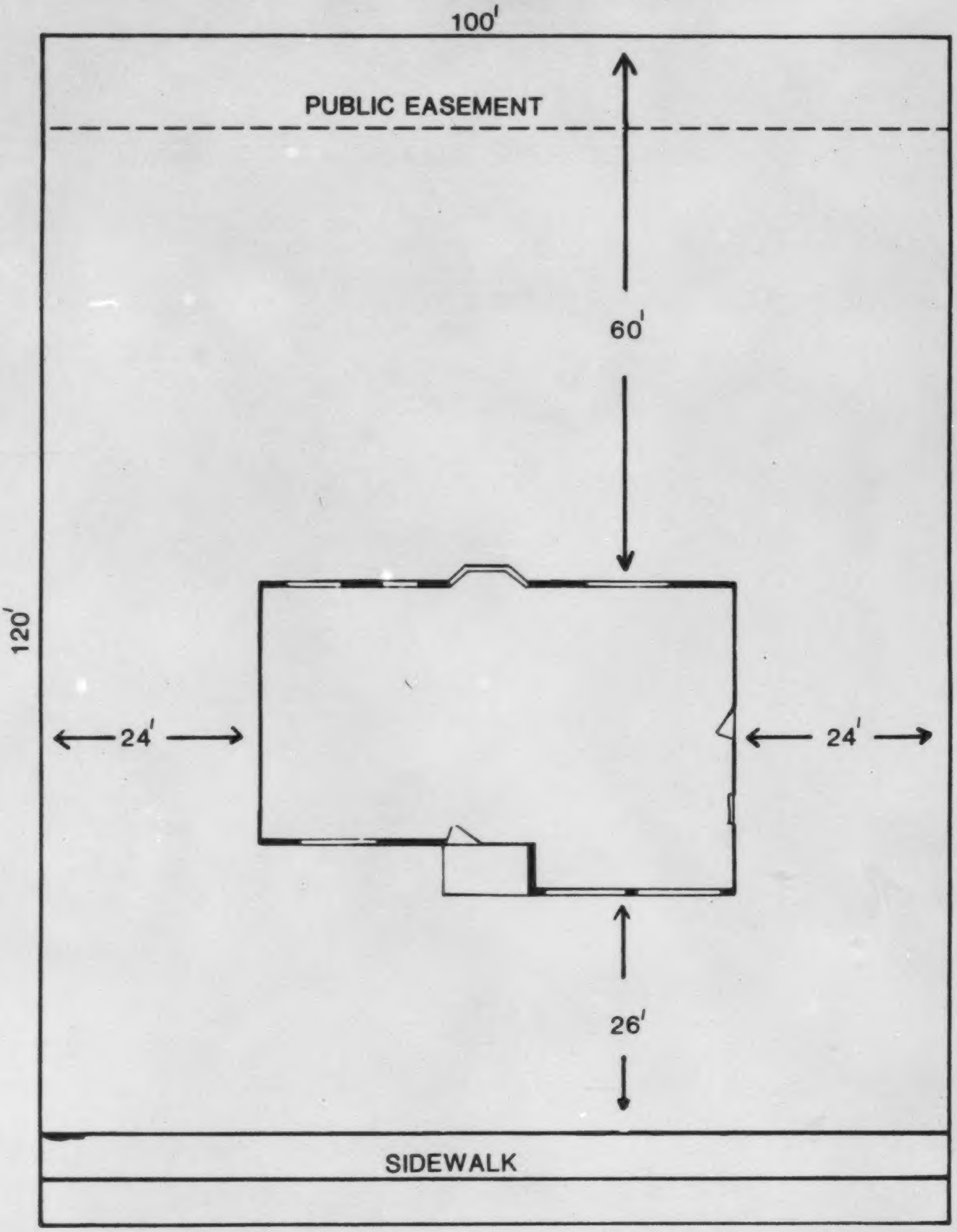

30'-0"
22'-0"
28'-5"
34'-0"
DINING
KITCHEN
FAMILY RM.
LIVING RM.
GARAGE

FIRST FLOOR


42'-0"
29'-0"
BED RM.
BED RM.
BED RM.
BED RM.
BED RM.

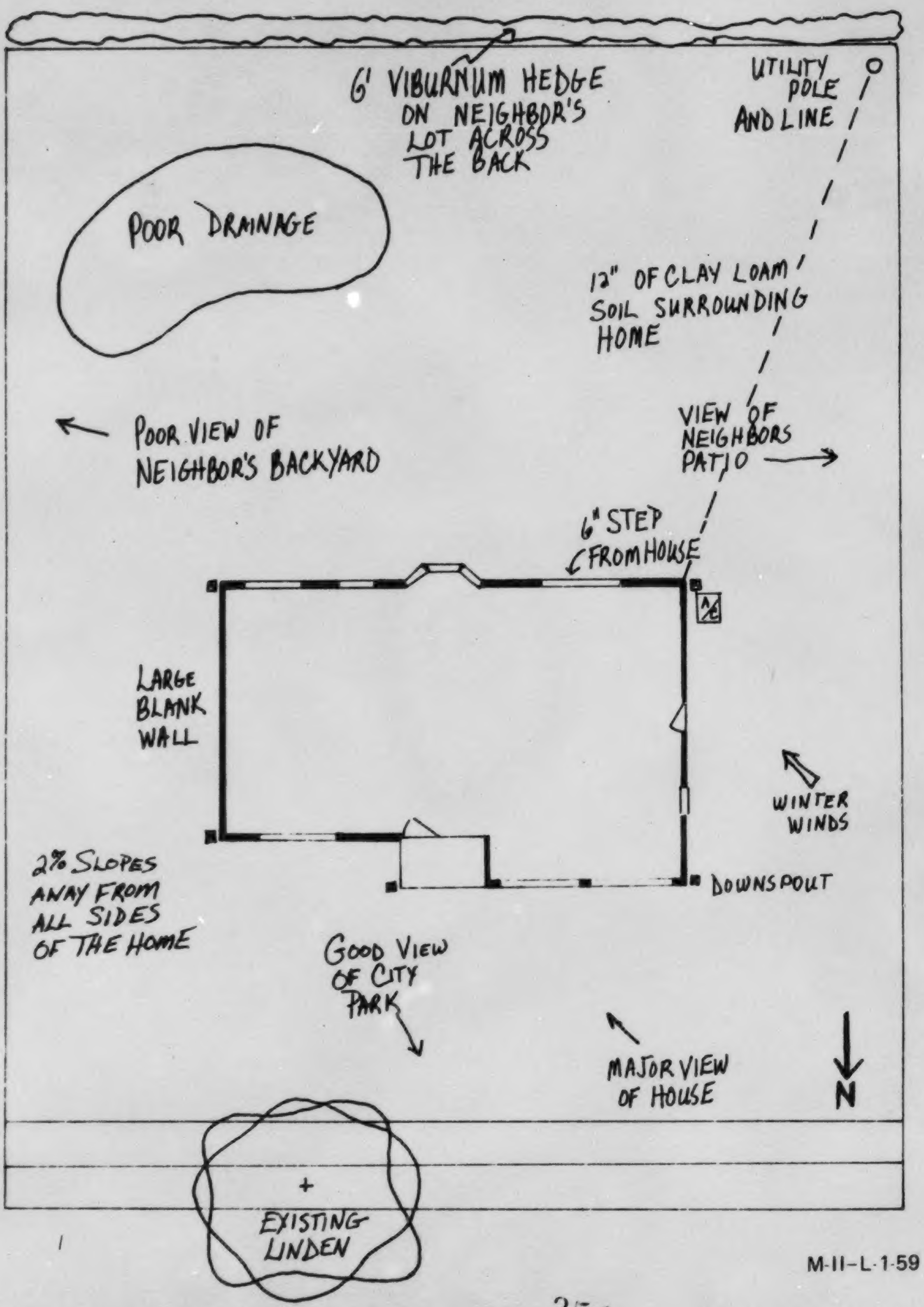
SECOND FLOOR

THE BASE PLAN


100'
PUBLIC EASEMENT
60'
120'
24'
24'
26'
SIDEWALK

SCALE 1"=16' 0"

THE SITE SURVEY


6' VIBURNUM HEDGE ON NEIGHBOR'S LOT ACROSS THE BACK
UTILITY POLE AND LINE
POOR DRAINAGE
12" OF CLAY LOAM SOIL SURROUNDING HOME
POOR VIEW OF NEIGHBOR'S BACKYARD
VIEW OF NEIGHBORS PATIO
6" STEP FROM HOUSE
A/C
LARGE BLANK WALL
WINTER WINDS
DOWNSPOUT
2% SLOPES AWAY FROM ALL SIDES OF THE HOME
GOOD VIEW OF CITY PARK
MAJOR VIEW OF HOUSE
N
EXISTING LINDEN

M-II-L-1-59

FAMILY INVENTORY CHECKLIST

Family Members:

Name	Age	Sex	Hobbies
Bill	38	M	Volleyball, Reading
Jane	34	F	Volleyball, Bird Watching
Bill Jr.	9	M	Sports
Chris	7	F	Likes to Play With Others
John	3	M	—

PUBLIC AREA:

Driveway ✓ Number of cars in family 2

Off-street parking needed? No

Privacy from street No Entry walk YES Entry garden or court YES

Landscape lighting No Structures (fences, walls, decks, etc.) No

OUTDOOR LIVING AREA:

General gardening:

Minimum maintenance ____ Moderate maintenance ✓

High maintenance ____

Family allergy considerations None

Special interests:

Hobby garden (specify) Vegetables

Flower borders: Annuals YES Roses 3-4 Plants

Perennials ____ Other ____

Fruit trees ____ Type ____

Small fruits (bush) ____ Type ____

Vine fruits ____ Type ____

Favorite plants ____

M-II-L-1-60

FAMILY INVENTORY CHECKLIST (continued)

Entertaining: Large groups ___ (over 10) Small groups ___ (under 10)
Formal ___ Informal ✓
Patio Material Brick

Permanent seating: Benches — Seat-height walls or planters ___
Shade required? YES Where? ___
Table umbrella YES Overhead structure ___
Trellis ___ Tree ___ Fabric canopy ___
Lawn games: YES Area lighted? NO
Specify: ___

Outdoor cooking: YES
Permanent grill NO Size ___ Gas ___ Charcoal ___
Portable grill YES Size Weber Grill
Barbeque pit NO
Sink NO Water NO Electrical outlets NO Storage NO
Swimming: NO Portable Pool ___ Size and Shape ___
Permanent Pool ___ Size (16' x 34' minimum) ___
Diving area ___ Shape ___
Paved decks ___ Size ___ Material ___
Enclosure for pool ___ Plants ___ Wire fence ___
Architectural wall or fence ___
Lighting ___ Dressing facility ___ Equipment storage ___

SERVICE AREA:

Vegetable garden YES Size 20'x20'
Flower-cutting garden NO Size ___
Compost bin YES Cold frames ___
Greenhouse NO Size ___
Dog run NO Size ___ Dog house ___
Other pet requirements ___
Clotheslines: Frequent use — Occasional use —
Permanent ___ Portable ___

FAMILY INVENTORY CHECKLIST (continued)

Recreational vehicle storage: Camper __—__ Size ______
Boat __—__ Size ______
Trailer __—__ Size ______

Lawn and garden storage: No. We will store these items in the garage

Equipment: Mower ______ Hose ______ Sweeper ______
Sprinkler ______ Spreader ______ Sprayer ______
Tools (itemize) ______

Supplies: Fertilizer ______ Peat Moss ______ Pesticides ______

Patio furniture (itemize) ______

Trash containers: Number ______ Preferred location ______

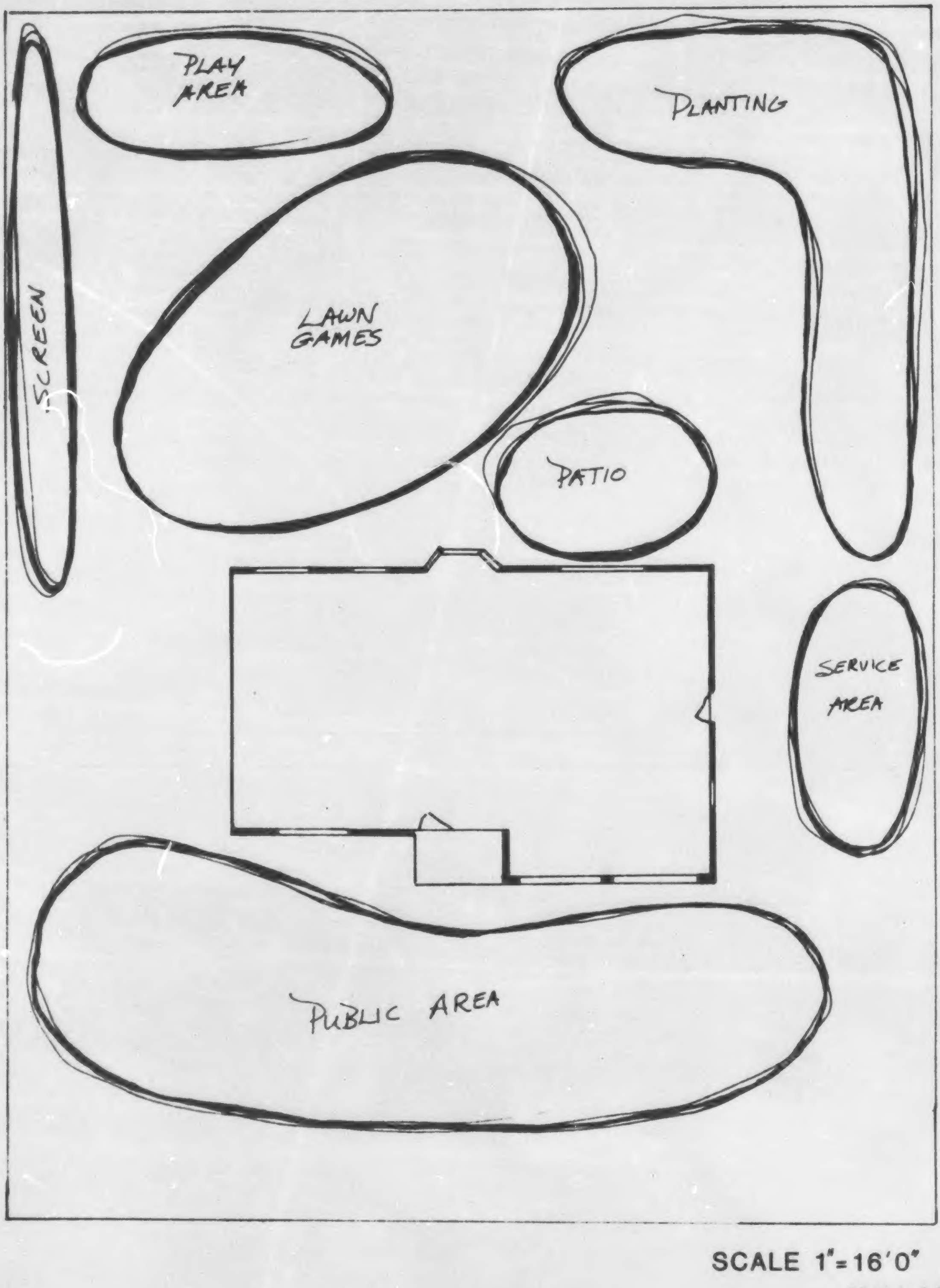
CHILDREN'S PLAY AREA

Climbing ropes ______
Sandbox __✓__ Slide ______ Swings __✓__
Playhouse ______ Jungle Gym ______
On paved surface? ______
Shade required? ______
Trees ______ Overhead structure ______
Fence ______ Height ______ Type ______
Surfacing material: Sand ______ Grass __✓__
Wood chips ______ Small gravel ______

GENERAL GARDEN ACCESSORIES AND FEATURES:

Sculpture ______ Landscape lighting ______
Water features ______: Fountain or spray ______
Reflecting pool ______
Fish ______ Plants ______
Bird interests: Bird feeder __✓__ Bird-attracting plants __✓__
Birdbath ______ Birdhouses ______

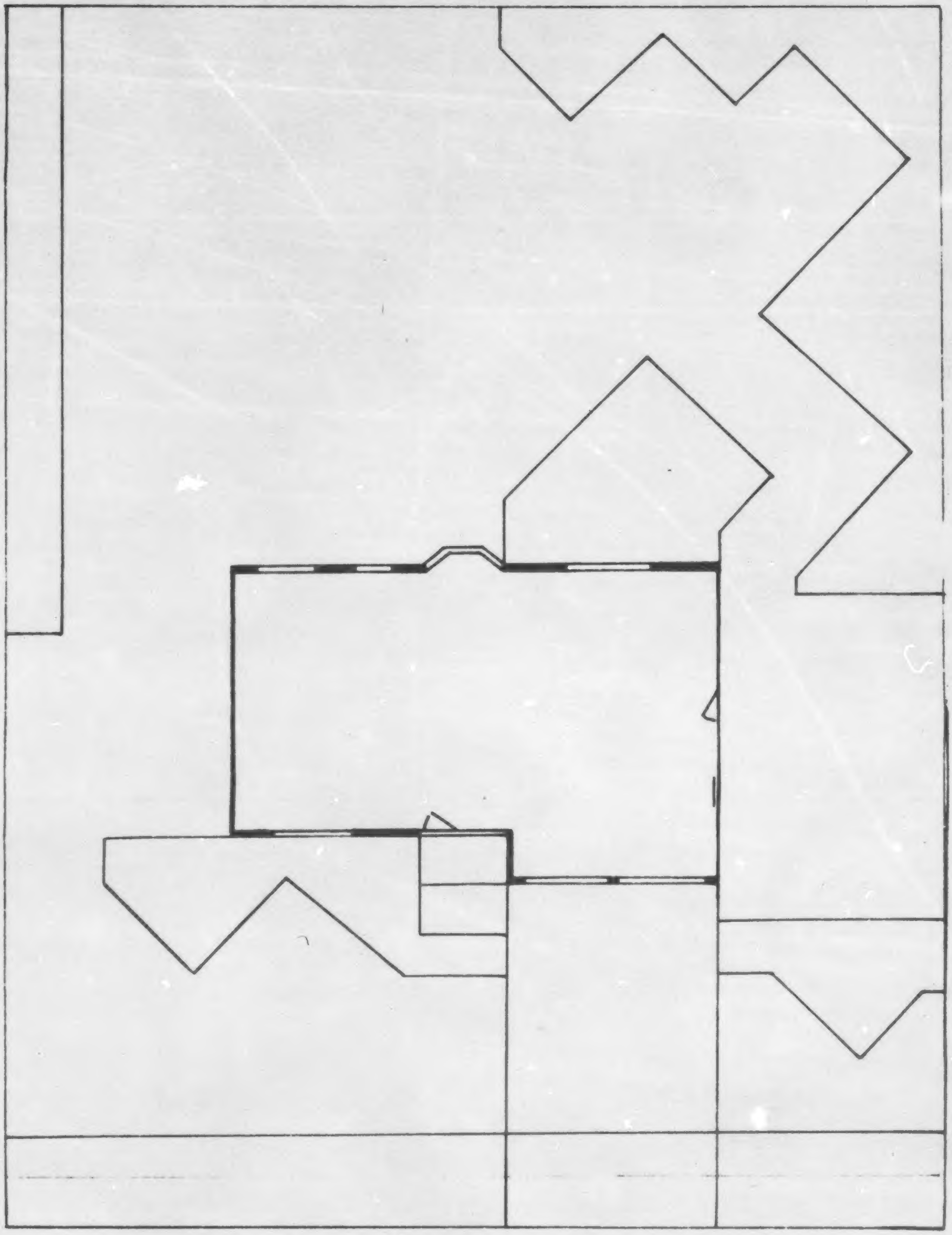
"GOOSE EGG" PLANNING


PLAY AREA
PLANTING
SCREEN
LAWN GAMES
PATIO
SERVICE AREA
PUBLIC AREA

SCALE 1"=16'0"

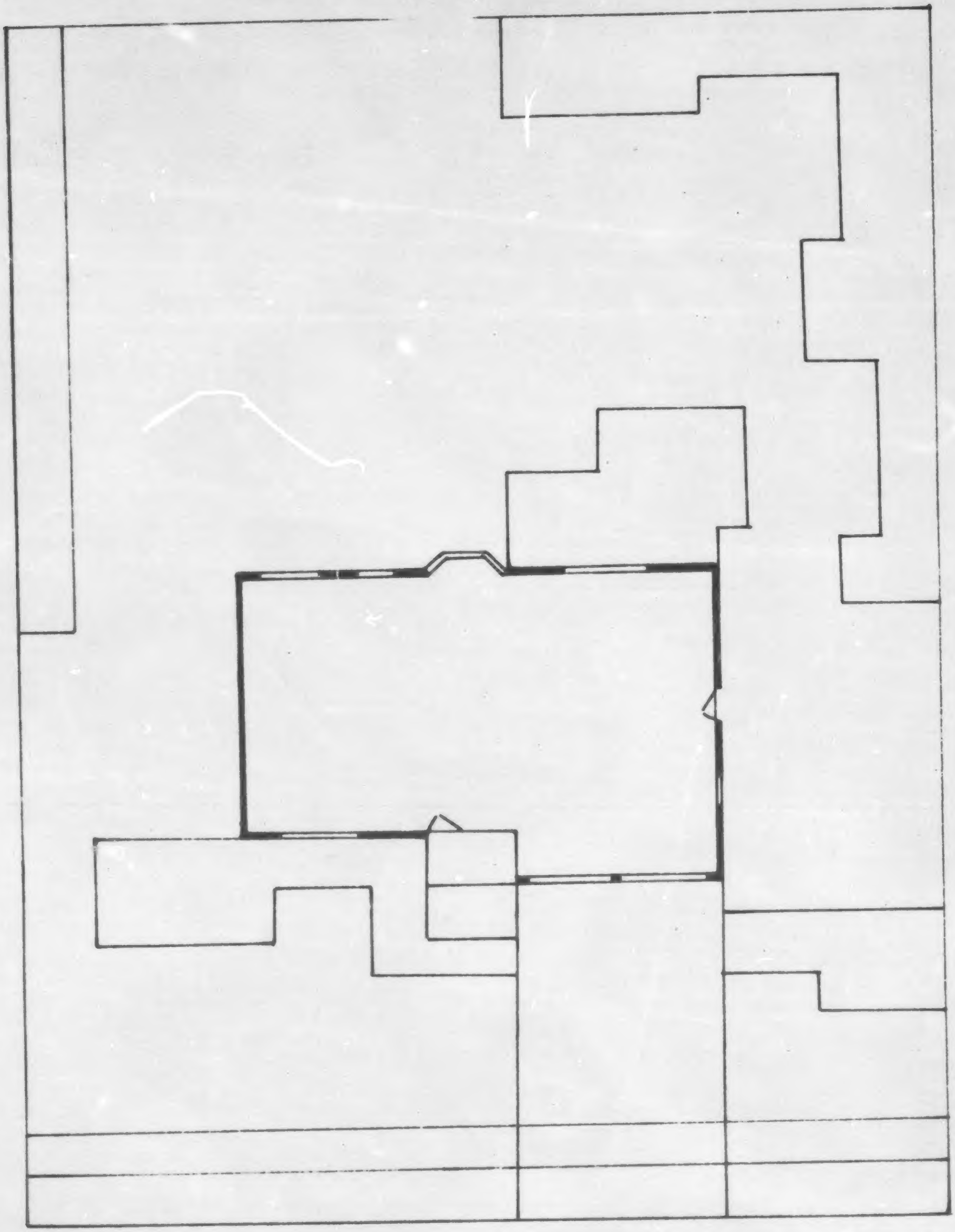
M-II-L-1-63

BED PATTERNS: 45% ANGLES



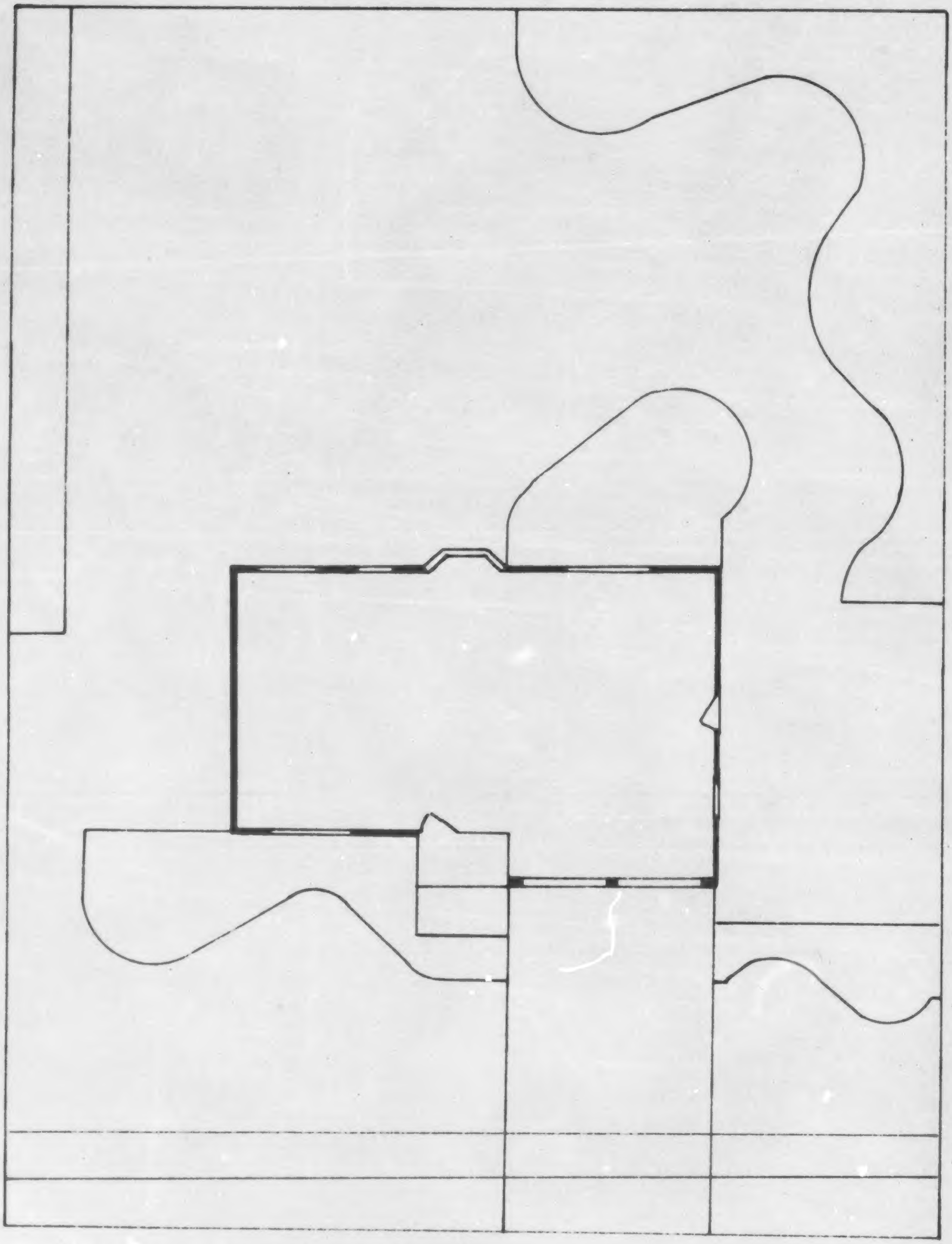
SCALE 1"=16'0"

BED PATTERNS: 90° ANGLES



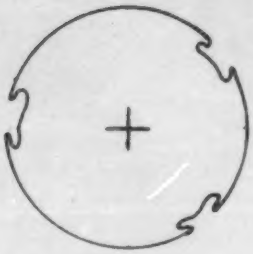
SCALE 1"= 16'0"

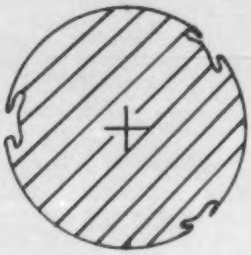
BED PATTERNS: ARC AND TANGENT

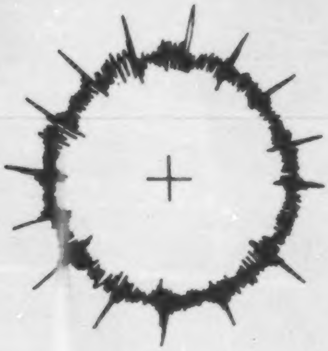


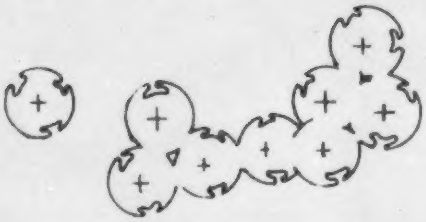
SCALE 1"=16'0"

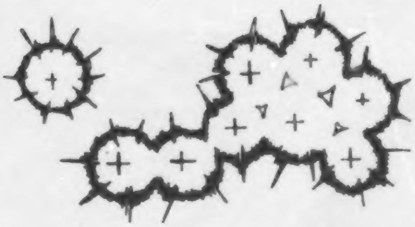
LANDSCAPE SYMBOLS

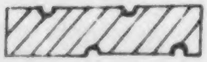

Deciduous Tree

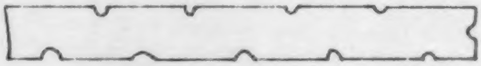

Broadleaf Evergreen Tree

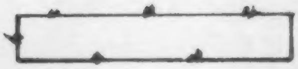

Evergreen Tree

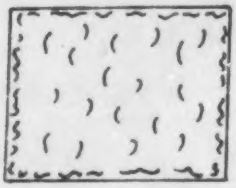

Deciduous Shrubs

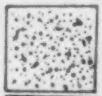

Evergreen Shrubs

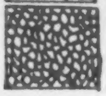

Broadleaf Evergreen Hedge


Deciduous Hedge


Evergreen Hedge

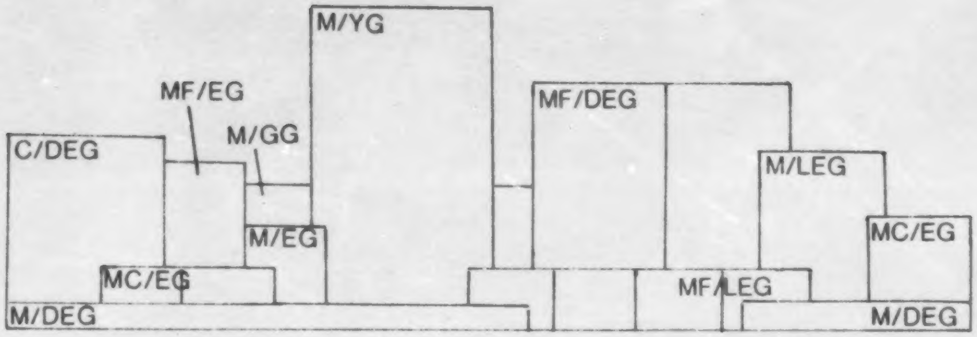

Ground Cover


Gravel


Cobbles

DESIGNING A SHRUB BORDER

STEP 1: Select plant's size, texture and color


M/YG
MF/EG
M/GG
C/DEG
MF/DEG
M/LEG
M/EG
MC/EG
MC/EG
MF/LEG
M/DEG
M/DEG

TEXTURE CODE

C	COARSE
MC	MEDIUM-COARSE
M	MEDIUM
MF	MEDIUM FINE
F	FINE

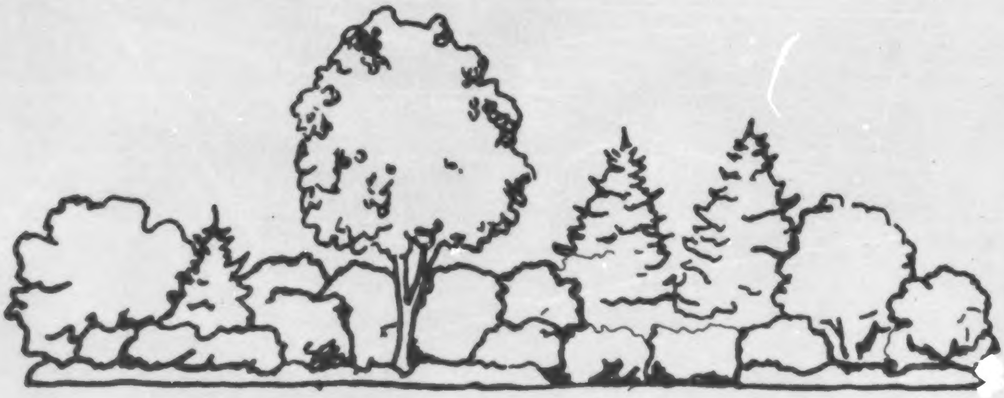
COLOR CODE

EG	EMERALD GREEN
BLG	BLUE GREEN
YG	YELLOW GREEN
RG	RED GREEN
GG	GREY GREEN
BG	BLACK GREEN

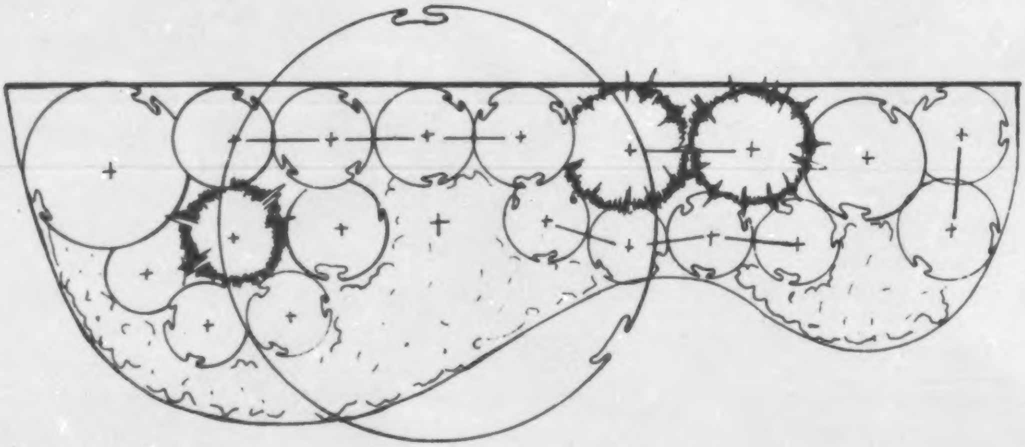
DESIGNING A SHRUB BORDER

(continued)

STEP 2: Sketch growth habits

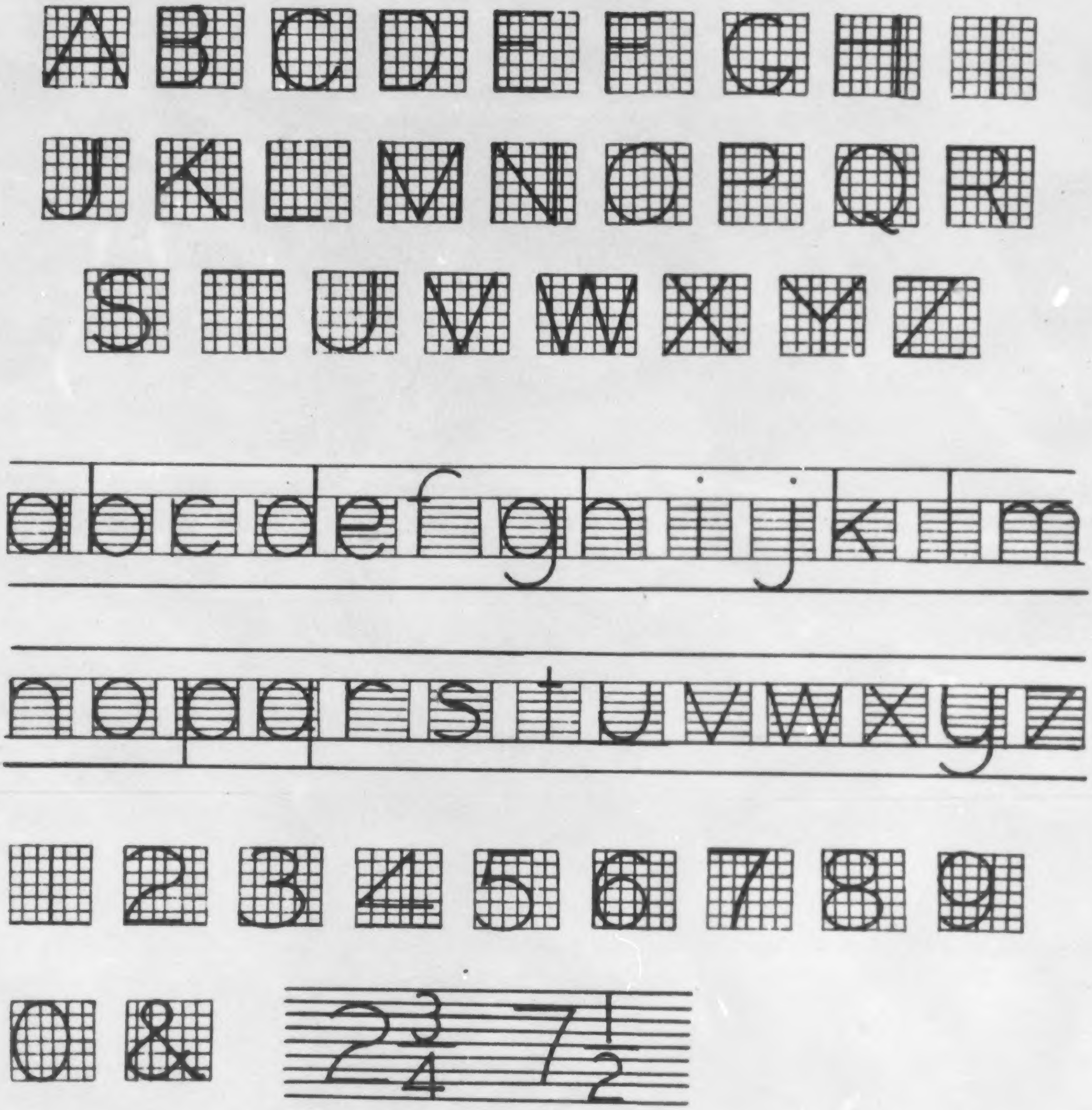


STEP 3: Place the plants in plan view

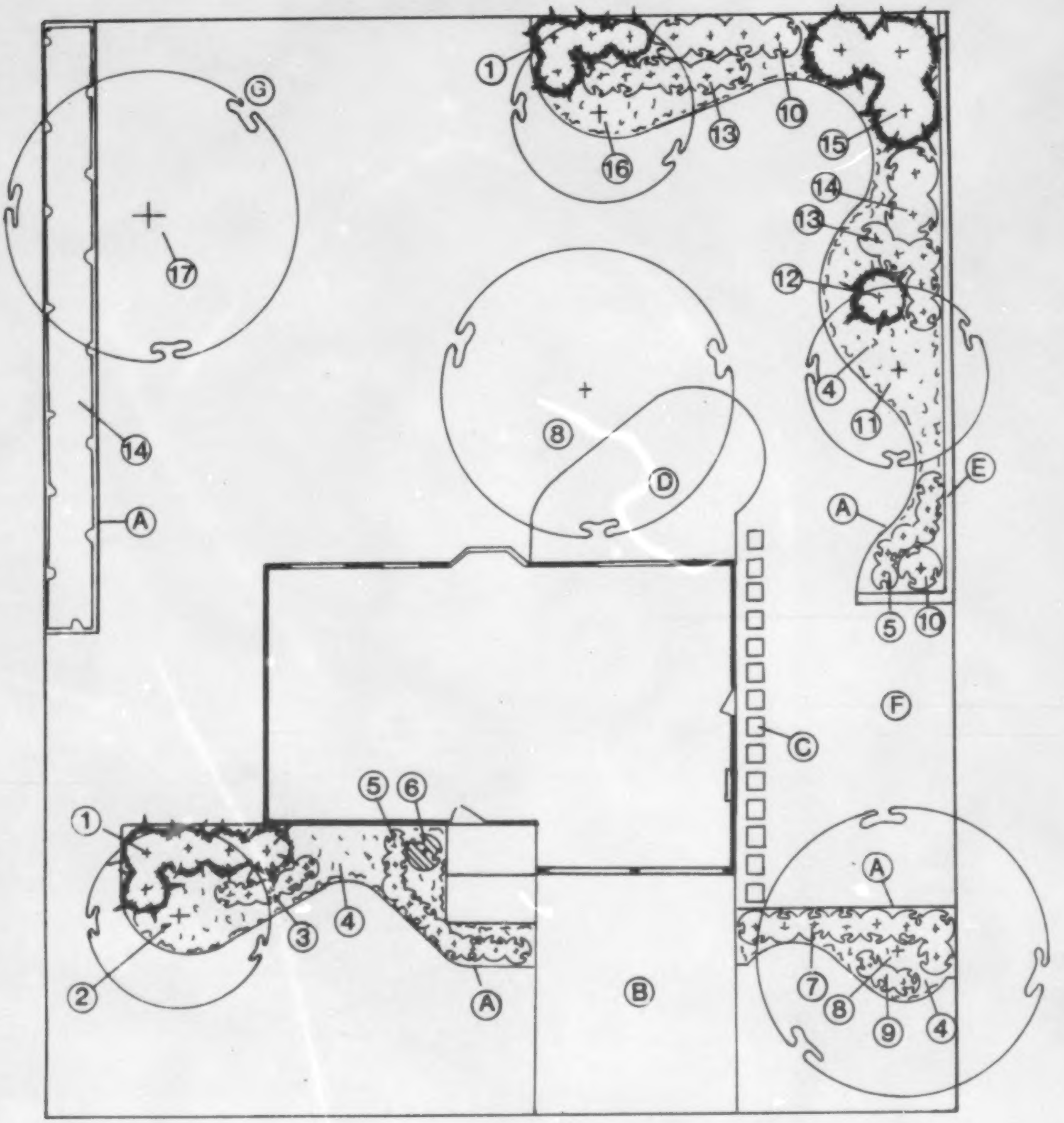


STEP 4: Select plants

LETTERING


A B C D E F G H I
J K L M N O P Q R
S T U V W X Y Z
a b c d e f g h i j k l m
n o p q r s t u v w x y z
1 2 3 4 5 6 7 8 9
0 &
2 3/4 7 1/2

PLANTING PLAN


1
G
10
13
15
16
17
14
13
12
8
D
4
11
E
14
A
A
5
10
F
C
1
5
6
A
A
3
4
2
A
B
7
8
9
4

SCALE 1= 16' 0"

PLANT LIST

1. Dense Yew
2. Eastern Redbud
3. Dwarf Fothergilla
4. Barren-Strawberry (12" O.C.)
5. Gold Drop Potentilla
6. Rhododendron P.J.M.
7. Clavey Dwarf Honeysuckle
8. Sugar Maple
9. Dwarf European Cranberrybush Viburnum
10. Compact European Cranberrybush Viburnum
11. Snowdrift Crabapple
12. Andorra Juniper
13. Shrubby St. Johnswort
14. Dwarf Winged Euonymus (2' O.C.)
15. Canadian Hemlock
16. Peach Tree
17. Red Oak

NOTES

A. Ryerson Steel Edging
B. Concrete Drive and Walk
C. 18" Stepping Stones
D. Brick Patio
E. 6' Board-on-Board Fence
F. Vegetable Garden
G. Play Area

TRANSPARENCY DISCUSSION GUIDE

STEPS IN LANDSCAPE DESIGN

This set of transparencies is intended to be a teaching aid for the problem area Drawing and Designing the Landscape Plan. They may be used to clarify the major steps taken when designing a landscape. Below is a brief explanation of each transparency to be read by the instructor.

Transparency: THE BASE PLAN

Every design should begin with the base plan. A base plan is a carefully drawn diagram indicating the lot lines, the outside walls of the house, public sidewalks and streets, and easements. It is important that this plan is drawn to scale (usually 1/8" = 1'0").

Transparency: THE SITE SURVEY

With a copy of the base plan, record on-site observations. Observations noted should include drainage conditions, soil conditions, existing vegetation, natural features (rocks, hills, etc.), climatic conditions (prevailing winds, sun or shade, etc.), permanent structures (fences, walks, drives, etc.), and views to and from the house.

Transparency: FAMILY INVENTORY CHECKLIST

Have the family complete a family inventory checklist. The checklist allows the family to organize their thoughts as to what they want in a landscape. Information collected should include family background, gardening interests, entertainment interests, and specific plants or structures desired.

Transparency: GOOSE EGG PLANNING

Information collected through the site survey and the family inventory checklist should be applied to the goose egg planning step. Place a sheet of tracing paper over the base plan and sketch approximate locations in which various activities (patio, service area, play area, etc.) will take place, as well as plantings and screens.

Transparency: BED PATTERNS

While referring to a goose egg planning diagram, sketch possible patio and bed patterns. Three accepted bed patterns are arc and tangent, 90° angles from the house, and 45° angles from the house. It is permitted to have one pattern in the outdoor living area and a different one in the public area.

Transparency: LANDSCAPE SYMBOLS

Here are various symbols which can be used to represent landscape elements on the landscape plan.

Transparency: DESIGNING A SHRUB BORDER

Four major steps in designing a shrub border:

Step 1. Sketch a series of blocks or rectangles representing various sizes of plant material desired. A scale of 1/8" = 1'0" is probably the most practical.

Step 2. Place the abstract composition at the top of a sheet of tracing paper. Below sketch the growth habits of plants to replace the blocks.

Step 3. Next indicate the texture and color of each mass. Begin with textures (C = coarse, MC = Medium-coarse, M = Medium, MF = Medium-fine, F = Fine). Foliage colors may be G = Emerald Green, BLG = Blue-Green, YG = Yellow-Green, RG = Red-Green, GG = Grey-Green, and BG = Black-Green.

Step 4. This step should be easy in that it requires the selection of plants and the placing of the plants in plan view below the growth habits sketch.

Transparency: LETTERING

Neat lettering contributes a great deal to the readability and appearance of a design. Carefully note how each letter is drawn.

Transparency: FINAL PLAN

This is an example of a final planting plan. The numbers and letters on the plan correspond with the plant list and construction notes.

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

DRAWING AND DESIGNING THE LANDSCAPE PLAN

Place your name on this test.

1-7. Place the following design steps in order from 1-7.

6 Selection of plants
3 Goose egg planning
2 Site survey
1 Base plan (plan of survey)
4 Bed patterns
5 Selection of plant sizes, textures, forms and colors
7 Final draft

True (+) False (0)

+ 8. The front door is the focal point of a landscape design.

0 9. Gazing balls, pink flamingos, tires, and bathtubs should be placed in the front yard, as they draw attention to the home.

0 10. Natural features of the land should not influence a landscape design.

+ 11. Pyramidal shrubs placed at corners of a house do little to tie the house to the surrounding.

+ 12. Family interest checklists are helpful in determining family needs and interests.

+ 13. Trees may be used to frame views, mask awkward architectural features, provide shade, and provide a backdrop for the home.

0 14. The ideal growth habit of an accent plant is tall and narrow with foliage to the ground.

0 15. Coarse textured plants give the illusion of distance.

+ 16. Cool colors (blue, green) tend to recede.

+ 17. Rounded plant forms are subtle and more pleasing to the eye than upright narrow plants.

Short answers.

18. Name the three major areas that are designed.
    The public area
    The outdoor living area
    The service area

19. Briefly explain what a site survey is.

    A site survey is a record of on-site observations on a sheet of tracing paper placed over the base plan. Observations may include topography, drainage, existing vegetation, natural features, climate, structures, walks and drives.

20. What is "goose-egg" planning?

    "Goose-egg" planning is the process of sketching the approximate locations that various activities (patio, service areas, play areas, etc.) will occur

21. Hedges can be formal (clipped) or informal (unclipped).

22. Three bed pattern designs are curved, straight and arc and tangent.

23. Form is the outline of a plant as well as the mass.

24. Texture is a plant's qualities of coarseness or fineness, roughness or smoothness, heaviness or lightness, thinness or denseness.

Multiple Choice

D 25. Which is not one of the three bed pattern design:
- a) arc and tangent
- b) curved
- c) straight
- d) saw tooth

B 26. The minimum recommended size of a patio is
- a) 30 square feet
- b) 300 square feet
- c) 100 square feet
- d) 3000 square feet

A 27. Seventy-two feet at one/eighth inch scale equals ______ inches.
- a) 9
- b) 8
- c) 7
- d) 6

B 28. Which two instruments combine most easily to create a vertical line?
- a) scale and T-square
- b) triangle and T-square
- c) scale and triangle
- d) protractor and T-square

A 29. Whenever drawing trees or shrubs the most important practice is
- a) to draw the plant at its mature size.
- b) to draw the plant at its actual size at planting.
- c) to draw the plant a little bigger than its mature size.
- d) it really doesn't matter as long as it is where you want it.

_D_ 30. Which is not a major consideration in designing?
- a) the landscape as viewed by those on the outside of the home
- b) the landscape as viewed by those on the inside of the home
- c) consider the lot to be like a room
- d) views from inside the neighbor's home

_D_ 31. A lawn serves to
- a) connect all other landscape elements.
- b) provide a broad expansive setting to the house.
- c) provide variety to the landscape design.
- d) both (a) and (b).

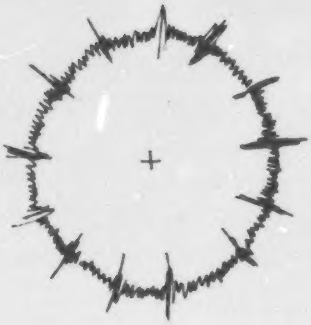
_C_ 32. Which is not an on-site observation?
- a) soil texture
- b) orientation of the home
- c) local zoning ordinances
- d) existing vegetation

_C_ 33. ________ implies equilibrium whether it be formal or informal.
- a) Repetition
- b) Variety
- c) Balance
- d) Scale

_D_ 34. Line, form, texture, and color uniformly repeated is________.
- a) variety
- b) balance
- c) emphasis
- d) repetition

35-42. Match the name with the appropriate symbol.

A. group planting of deciduous shrubs
B. deciduous hedge
C. 30°-60° triangle
D. scale
E. T-square
F. deciduous tree
G. evergreen
H. broadleaf evergreen shrub
I. broadleaf evergreen hedge
J. 45° triangle
K. ground cover
L. evergreen hedge
M. group planting of evergreen shrubs



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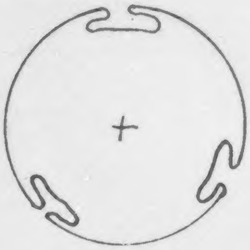

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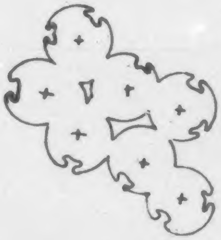

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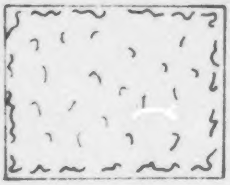

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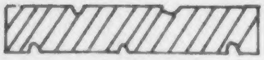

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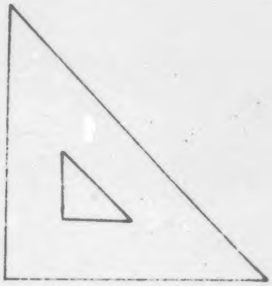

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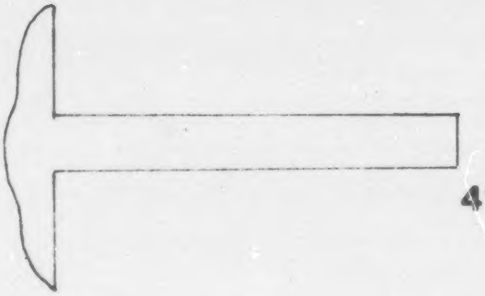

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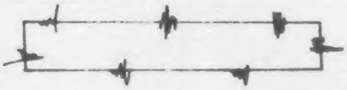

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UNIT L: LANDSCAPE DESIGN, ESTABLISHMENT AND MAINTENANCE

PROBLEM AREA: ESTABLISHING AND MAINTAINING A TURF AREA

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the latter portion of the spring semester.

The estimated instructional time for this problem area is 8 to 10 days, depending on how far the teacher wishes to go in developing turf establishment and maintenance skills. If the teaching plan is limited to classroom discussion, with little or no practice or observation, the instructional period can be 6 days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

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The teacher's guide, student worksheets and test questions were developed by Charles Wanner, Lincolnway High School. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Pilot Test Teachers.

TEACHER'S GUIDE

I. Unit: Landscape design establishment and maintenance

II. Problem area: Establishing and maintaining a turf area

III. Objectives:

1. Given a planned turf site, the student will outline the basic steps in preparing the site and establishing a turf through seeding.

2. Given a prepared seedbed, the student will demonstrate the procedure of vegetative turf establishment through stolonizing, plugging and sprigging.

3. Given an area to be sodded, the student will demonstrate the proper method of removing sod from an established sod producing area and transplanting the sod on a prepared turf site.

4. Given the appropriate tables and charts, the student will calculate fertilizer recommendations for an established turfgrass area.

5. Given an established turfgrass area, the student will develop a maintenance plan which outlines proper methods of watering, mowing and thatch control.

IV. Suggested interest approaches:

1. Have students evaluate their home lawns or a specified turfgrass site and share their findings in a class discussion.

2. Plan a tour to local homes or commercial sites where preparations are being made to establish new turf areas. Ask students to give their ideas on steps that should be taken to establish the turf.

3. Invite a person involved in the turfgrass industry to the class to discuss occupations related to turfgrass establishment and maintenance.

4. Contrast proper and improper turfgrass maintenance practices through the use of photographs or a tour of several turfgrass sites. Ask the class to suggest possible aspects of the maintenance procedures that would explain the differences in appearance of the various turfgrass areas.

V. Anticipated problems and concerns of students:

Objective 1.

1. What is meant by "rough grading?"
2. What conditions warrant the application of limestone to the turfgrass site?
3. How do you calculate the amount of fertilizer and lime that should be applied to an area that will be seeded?
4. How is fertilzer and lime applied to the site?
5. What are the steps in preparing a seedbed for turfgrass?
6. What time of year is best for establishing a turfgrass area through seeding?
7. What methods and equipment are used to plant seed?
8. How should you maintain a newly seeded area?

Objective 2.

1. How is a turfgrass area established through stolonizing?
2. How is a turfgrass area established through sprigging?
3. How is a turfgrass established through plugging?
4. Why are vegetative methods used to establish a turfgrass area?

Objective 3.

1. What conditions justify the use of sod as a method of turfgrass establishment?
2. What are the methods used to cut sod?
3. What time of year is best for laying sod?
4. How is sod placed on a prepared site?
5. How do you maintain new sod?

Objective 4.

1. What nutrients are important to the growth of a turfgrass plant?

2. How do you conduct a soil test?

3. How is information from a soil test used to develop fertilizer recommendations for a turfgrass area?

4. What types of information do you get from a soil test?

Objective 5.

1. What is a turfgrass maintenance plan?

2. How much does it cost for a total maintenance program?

3. How is the correct mowing height determined?

4. How do you determine mowing frequency?

5. What types of equipment are used for mowing?

6. How often should a turfgrass area be watered?

7. How much water should be applied each time you irrigate a turfgrass area?

8. What time of day is best for watering?

9. What is thatch?

10. Why is it undesirable to have an accumulation of thatch in a turfgrass area?

11. What methods are used to control the buildup of thatch?

VI. Suggested learning activities and experiences:

1. Have students develop a written plan for turfgrass establishment at a specific site.

2. Set up a turfgrass demonstration area using the Laboratory Exercise included with this problem area. Students prepare, seed and maintain the turf plots. During the establishment of plots, students have the opportunity to 1) take soil samples for testing 2) calibrate spreaders and apply fertilizer and lime 3) till soil 4) calibrate seeders and seed 5) cover seed and roll 6) mulch and water 7) care for new grass.

3. Arrange a field trip to a sod farm or golf course and have a resource person available to explain turf uses and propagation methods.

4. Repair the school lawn by plugging (use turf raised by the class or turf moved from a denser area).

5. Plant flats of turfgrass by sprigging. (e.g., Zoysiagrass, Creeping Bentgrass).

6. Visit a home or commercial site to view the procedure of laying sod. Students should keep an observation record which outlines the basic steps of laying sod.

7. Collect soil samples from various locations on the school grounds. Prepare the samples for testing at a soil testing service or conduct tests in class. Student should be responsible for recording locations of samples and results of testing.

8. Discuss turfgrass nutrients and observe deficiency symptoms. (Photographs, areas around the school, experiments in the turf demonstration plots.)

9. Grow flats or demonstration plots of turfgrasses. Conduct experiments to show the influence of varying amounts of plant nutrients on turf growth and development. Students monitor experiments and keep records of developments. Discuss the results in class.

10. Bring sample fertilizer bags into the classroom. Students complete worksheet dealing with the interpretation of information on a fertilizer bag.

11. Students role-play as turfgrass maintenance specialists. Divide the class into groups of 3-4. These groups will represent turfgrass maintenance companies. Assign each group the task of developing a maintenance plan for a given set of conditions. Each group ("company") explains their plan to the rest of the class. (Other class members play the role of "customers" - "companies" attempts to sell their maintenance plans.)

12. Visit a local garden shop and observe various types of fertilizers on the market. (Compare costs and nutrients available.)

13. Visit a golf course and observe the various pieces of turf maintenance equipment in operation. Students keep notes on observations, to be used in the development of maintenance plans.

14. Students measure the water distribution of a sprinkler system by placing cans on a lawn in a grid.

15. Cut a cross section from a turfgrass site. Use the cross section to show students the accumulation of thatch.

16. Choose one or two of the maintenance plans developed by the class members and work as a group to estimate the cost

of initiating the plans. Individuals can be assigned the task of locating the costs for specific portions of the plan.

VII. Application procedures:

1. Students apply knowledge in a public service project involving the establishment and maintenance of a turf area.

2. The information presented in this problem area can be applied in S.O.E. projects related to turfgrass establishment or maintenance.

3. Students apply the knowledge and skills obtained in this problem area to their home lawn situation.

VIII. Evaluation:

1. Prepare and administer a paper and pencil test covering the material presented in the problem area.

2. Grade worksheets completed by the students.

3. Grade students plans for turfgrass establishment and maintenance.

IX. References and aids:

1. Booklets and Circulars

Illinois Lawn Care and Establishment, University of Illinois, Cooperative Extension Service, Circular 1082, pp. 1-9 and 23-24.

Mowing Your Lawn, University of Illinois - Cooperative Extension Service, Circular 1050.

2. Information Sheets

Fertilizer Recommendations for Turf by J. R. Street and A. J. Turgeon. Horticulture Facts Series, University of Illinois Cooperative Extension Service. TG 2-79.

3. VAS Subject Matter Units

4001 "Collecting and Preparing Soil Samples for Testing"

5008 "Establishing a Lawn"

4. VAS Slidefilms

   651 "Steps to a Better Lawn" (obtain tape and Student Guide)

5. VAS Slide Sets

   S651 "Steps to a Better Lawn"

STUDENT WORKSHEET

INTERPRETING INFORMATION ON FERTILIZER BAG LABELS

Fertilizer Bag #1

1. What is the analysis of this fertilizer?
2. This fertilizer has ___ percent available nitrogen.
3. What form of phosphorus is represented in the analysis?
4. How many pounds of this fertilizer should be added per 1000 square feet of a new lawn?
5. What company produces this fertilizer?

Fertilizer Bag #2

1. This fertilizer has ____ percent available phosphorus.
2. Name 3 weeds that can be controlled with this Weed and Feed mixture.
3. When are weeds easiest to kill with this product?
4. When would you apply this fertilizer to your lawn?
5. Should you allow this product to drift onto desirable plants, shrubs or flowers?

Fertilizer Bag #3

1. This fertilizer has ____ percent available potassium.
2. What form of potassium is represented in the analysis of this fertilizer?
3. What is the potential acidity of this fertilizer?
4. What rate of application would you use on a new lawn?

STUDENT WORKSHEET

DEVELOPING A PLAN FOR TURFGRASS ESTABLISHMENT

Assignment: Develop a plan for the establishment of turf on the described site. Use the given outline as a guide in setting up your plan for establishment.

Site Description: The site for turfgrass establishment is a level, 50 foot by 40 foot area. Most of the area is shaded by oak and hickory trees. The soil is sandy and tends to be drouthy during the summer months. A soil test from the site provides the following information:

Phosphorus	30 lbs./acre
Potassium	170 lbs./acre
pH	5

Outline for Turfgrass Establishment Plan

I. Site Preparation

   A. Grading.
   B. Control of perennial weedy grasses.

II. Fertilization and Liming

   A. Amount of phosphorus and potassium applied.
   B. Amount of lime to be applied.
   C. Methods of application.

III. Soil Preparation

   A. Basic steps in preparation.
   B. Tools used in soil preparation.

IV. Selecting the Right Grass

   A. Factors considered when choosing a turf species.
   B. Species, mixture, or blend for the given situation.

V. Method of Planting

   A. Will you establish the turf through seeding, sodding or vegetative planting (plugging, stolonizing, sprigging)?
   B. What procedures and tools are used for planting?

VI. Care of Newly Established Turf Area

   A. Methods used to reduce erosion and drying.
   B. Amount and timing of irrigation for the new turfgrass area.

STUDENT WORKSHEET

DEVELOPING A PLAN FOR TURFGRASS MAINTENANCE

Assignment: Develop a plan for the maintenance of the turfgrass on the described site. Use the given outline as a guide in setting up your plan for maintenance.

Site Description: The turfgrass site to be maintained is a level, 60 foot by 200 foot area which is in open sun. Kentucky Bluegrass is the major turfgrass species on this area. The following potential pest problems have been identified on the site:

Weeds - Dandelion, Broadleaf Plantain, Crabgrass, Goosegrass
Insects - Sod Webworm
Diseases - Fusarium Blight

A soil test from the site provides the following information:

Phosphorus	30 lbs./acre
Potassium	170 lbs./acre
pH	5

Outline for Turfgrass Maintenance Plan

I. Fertilizer and Lime Applications

A. Fertilizer

1. Type of fertilizer (analysis).
2. Rate of fertilizer application.
3. Time of year for application.
4. Tools and equipment used in application.

B. Lime

1. Rate of application.
2. Time of year for application.
3. Method of application.

II. Pest Control

A. Weed Control

1. Conditions that would make herbicide use necessary.
2. Herbicide(s) used for weed control.
3. Time of application.
4. Method of application.

B. Insect Control

1. Conditions that would make insecticide use necessary.
2. Insecticide(s) used for insect control.
3. Time of application.
4. Method of application.

C. Disease Control

1. Conditions that would make chemical control necessary.
2. Chemical used for control.
3. Time of application.
4. Rate of application.

III. Mowing

A. Type of mowing equipment.
B. Height of cutting.
C. Frequency of cutting.
D. Will clippings be removed?

IV. Irrigation

A. Frequency of watering.
B. Amount of water applied.

V. Thatch Control

A. Timing of thatch removal.
B. Equipment for thatch removal.

LABORATORY EXERCISE

ESTABLISHING A TURFGRASS DEMONSTRATION PLOT

Purposes

1. To display different turfgrass species.
2. To study the effects of different management practices.
3. To practice turfgrass establishment through seeding, vegetative methods and sodding.
4. To gain experience in soil testing.

Materials

1. Land for the demonstration plots. Try to secure a site that is easily accessible to students and the public. A water source should be located near the plot.
2. Signs to mark the turfgrass plot.
3. Seeds and vegetative parts to be used in the establishment of the turfgrass species.
4. Equipment for the establishment and maintenance of turfgrasses (rototiller, rakes, seeder, roller, fertilizer spreader, irrigation equipment, mower).
5. Soil testing equipment to use in determining the lime and fertilizer requirements.
6. Fertilizers of different analysis to be used for comparative purposes on the turfgrass plots. Lime may be required to correct the pH.

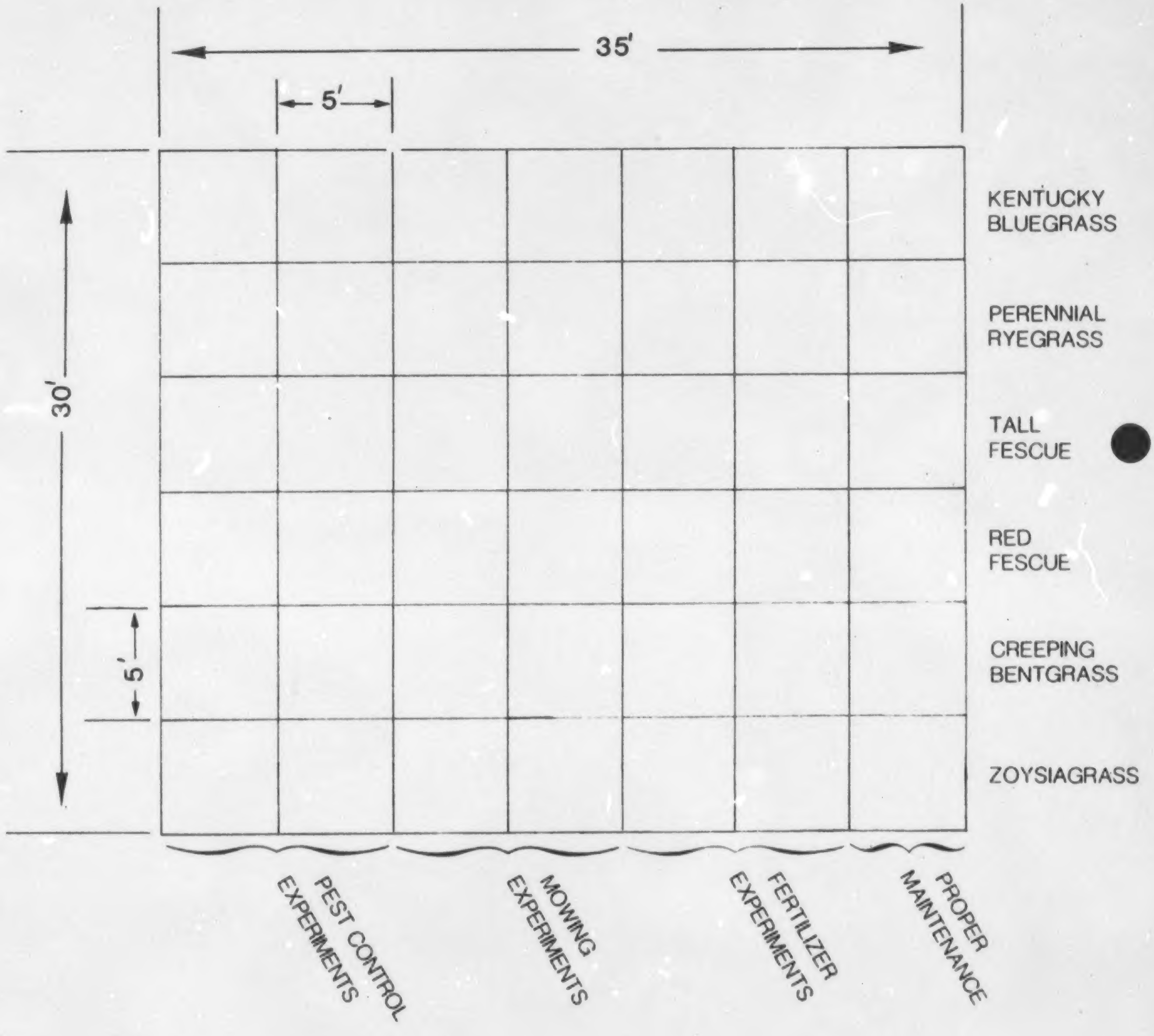
Procedure

1. Select an area of land that is easily accessible for students and the public.
2. Conduct soil tests to determine fertilizer and lime needs.
3. Prepare the area for the establishment of the turfgrass species (rough grade, till, smooth grade).
4. Mark off the area into individual plots. The plots should be marked with signs which identify the turfgrass species, the date of planting and any modifications in establishment or maintenance practices.
5. Establish the turfgrass species according to the demonstration plot plan.

6. Perform the maintenance practices that are outlined on the demonstration plot plan.

7. Record the observations that are made for each turfgrass plot.

EXPERIMENTAL TURFGRASS PLOTS


35′
5′
30′
5′
KENTUCKY BLUEGRASS
PERENNIAL RYEGRASS
TALL FESCUE
RED FESCUE
CREEPING BENTGRASS
ZOYSIAGRASS
PEST CONTROL EXPERIMENTS
MOWING EXPERIMENTS
FERTILIZER EXPERIMENTS
PROPER MAINTENANCE

SAMPLE TEST QUESTIONS AND

TEACHER'S KEY

ESTABLISHING AND MAINTAINING A TURF AREA

1. How could you determine the plant nutrient levels on a site where you plan to establish turf grass?

   Conduct a soil test.

2. What are the 3 basic nutrients needed by turfgrasses?

   Nitrogen, phosphorus, potassium.

3. The best soil pH range for turfgrass growth is 6.0 - 6.5.

4. If your soil test indicates a pH of 4.0 for the turfgrass site, you should apply Lime to reach a pH more appropriate for turfgrass growth.

5. A soil test is useful in determining the B needs for a given site.

   A. Nitrogen
   B. Phosphorus, Potassium, pH
   C. Nitrogen, Phosphorus, Potassium, pH

6. The fertilizer analysis gives the percent composition of the fertilizer.

7. You have a fertilizer bag which has the number 15-10-5. What percentages of nitrogen, potassium and phosphorus are contained in this fertilizer?

   Nitrogen = 15%
   Phosphorus = 10%
   Potassium = 5%

8. When you set out to establish a lawn, you should begin by C .

   A. Mulching the seedbed.
   B. Raking the area to cover seed.
   C. Controlling weedy perennial grasses and grade the site.

9. T or F. You should work in (incorporate) phosphorus and potassium nutrients into the soil as it is tilled for seedbed preparation. T

10. The soil at a new turfgrass site should be tilled to a depth of about 6 inches.

11. List two reasons why it is beneficial to till the soil before a turfgrass is established.

    1. Improves the movement of water into and through the soil.
    2. Improves soil aeration.

12. Briefly explain why it is important to smooth grade a turfgrass seedbed.

    Smooth grading removes the high and low spots on a site. The low spots might collect water and damage the grass. High spots tend to dry out faster and may cause wilting.

13. The best time of year for seeding a turfgrass area is A.

    A. Late summer to early fall.
    B. Middle of the summer.
    C. Late winter and early spring.

14. Put the following steps in turfgrass establishment through seeding in the proper order by placing the numbers 1-8 in the blanks next to the steps.

    5 Place the seed on the area with a mechanical seeder.

    7 Roll the seeded area lightly to firm the surface.

    2 Till the soil with a rototiller and apply phosphorus, potassium and lime.

    1 Rough grade the seedbed.

    6 Rake the area lightly to cover seed.

    4 Apply a starter fertilizer.

    3 Smooth grade the area to achieve a uniform surface.

    8 Mulch the seeded area with weed-free straw or other material.

15. Grass seed should be distributed uniformly on the seedbed and covered with no more than B inches of soil.

    A. 2
    B. ¼
    C. 1

16. List 2 advantages of mulching a new turfgrass seedbed.

    1. Reduces drying of the seedbed.
    2. Helps reduce erosion.

17. Vegetative planting methods such as stolonizing, sprigging and plugging are used when __C__ .

A. You have a very large site to plant.
B. There is a steep slope on the site.
C. When seed for a particular turf is scarce.

18. Briefly describe the procedure of turfgrass establishment through stolonizing, sprigging, and plugging.

Stolonizing - Shredded stolons are spread over the area with mechanized equipment. Spreading is followed by disking or rolling.

Sprigging - The planting of individual plants, runners, cuttings or stolons at spaced intervals.

Plugging - Planting small plugs or blocks (2 or more inches wide) of sod at measured intervals.

19. Sod should not be cut more than __C__ inch(es) thick.

A. 3
B. 1/8
C. 1

20. When putting in sod, the slabs should be __D__ .

A. All laid in the same direction.
B. Laid so the edges butt tightly together.
C. Laid so the ends are staggered as in laying bricks.
D. All of the above.

21. Cutting height and __C__ should determine the mowing frequency.

A. Amount of fertilizer required.
B. Slope of the land.
C. Rate of growth.
D. Time of day.

22. Describe the disadvantage of using light, frequent irrigations to maintain the turfgrass area.

Often results in the deterioration of the lawn as a result of shallow rooting, increased disease incidence, weed development and insect damage.

23. When the turfgrass site is irrigated, enough water should be applied to moisten the soil to a depth of six inches. This is roughly equivalent to applying __B__ inch(es) of water.

A. 2
B. 1
C. 5

24. A general rule for mowing states that you should not remove more than __C__ of the total foliage at any one mowing.

A. 1/5
B. 1/2
C. 1/3

25. Name the two principal types of mowers used in the maintenance of turfgrass sites.

1. Reel mowers.
2. Rotary mowers.

26. T or F The procedure used to prepare a seedbed for sodding is the same as that used to prepare an area for seeding. __T__

UNIT L: LANDSCAPE DESIGN, ESTABLISHMENT, AND MAINTENANCE

PROBLEM AREA: CONSTRUCTING PATIOS AND WALKWAYS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the spring semester.

The estimated instructional time for this problem area is 3 to 7 days, depending on how far the teacher wishes to go in developing construction skills at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be 3 days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

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The teacher's guide, student worksheet, and test questions were developed by Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Transparency masters were prepared by the Vocational Agriculture Service, University of Illinois, from drawings done by William R. Nelson, Jr., Horticulture Department, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Pilot Test Teachers.

TEACHER'S GUIDE

I. Unit: Landscape design, establishment and maintenance

II. Problem area: Constructing patios and walkways

III. Objectives: At the close of this problem area, students will:

1. Be able to identify various construction materials used in constructing patios and walkways.

2. Be able to construct a brick patio or walk.

IV. Suggested interest approaches:

1. Ask if any of the students are interested in becoming landscape contractors or landscape foremen.

2. Ask if any students are interested in doing any landscape construction around their home.

3. Pass photographs of dilapidated patios and walkways around the class. Then ask a series of questions:

    a. What is wrong with the structures?

    b. How should the structures have been constructed?

V. Anticipated problems and concerns:

1. What materials can be used for edging?

2. What materials are commonly used for patios and walkways?

3. Why is sand or gravel placed beneath the paving material?

4. What is the purpose of having solid edges for free-land brick or flagstone?

5. How can I keep water from standing on a patio or walkway after a rain?

6. Does wood used outside need to be treated to prevent decay?

7. Why is black plastic placed beneath gravel or bark chips?

8. How much space should be left between bricks?

VI. Suggested learning activities and experiences:

1. Bring various edging materials to class and discuss the advantages and disadvantages of each.

2. Show VAS Slide Set 628: "Walks, Steps, and Retaining Walls."

3. Bring various surfacing materials used for patios and walks to class and discuss their attributes and uses.

4. Discuss specifications for laying brick, flagstone, asphalt, concrete, and loose aggregates. Show the transparencies on patios and walkways, and refer to problem area "Cement Masonry and Concrete Work."

5. Show VAS Slide Set 628: "Fencing and Patios."

6. Discuss patio construction.

7. Have the students complete the worksheet, "Planning a Patio Construction Project."

8. Construct a walkway on the school grounds as a class project.

VII. Application procedures:

1. Skills learned in constructing landscape structures should be applied in the student's home situation.

2. Skills learned in this problem area will aid students working for landscape contractors, garden centers, and city or park district forestry divisions.

3. The students should use the skills learned to complete their S.O.E. projects.

VIII. Evaluation:

1. Provide a written test at the end of this problem area.

2. Give a lab test on the identification of materials used in construction of patios and walkways.

IX. References and aids:

1. University of Illinois Cooperative Extension Circular 1111, Landscaping Your Home, Chapter 5.

2. University of Illinois, Vocational Agriculture Service.

   a. Slidefilms

628	Walks, Steps and Retaining Walls	80 frames
629	Fencing, Patios	73 frames

   b. Transparency Sets:

Landscape Construction Accessories	74 frames
Landscape Construction Transparencies	86 frames

3. Transparencies included with this problem area.

4. Reader's Digest Practical Guide to Home Landscaping, 1977. The Reader's Digest Association, Inc., Pleasantville, New York.

INFORMATION SHEET
LANDSCAPE PAVINGS

	GENERAL COMMENT	ADVANTAGES	DISADVANTAGES	INSTALLATION
ASPHALT	Break up area with dividers; contrast color and texture with nearby plants, brick concrete, or wood. Asphalt-cement combination is light and inexpensive.	One of the cheapest of the pavings. Fairly easy to apply. No glare or reflected heat. Can be colored.	If the base moves, it is liable to have dips and cracks. Gets soft and quite hot in full sun; some metal lawn furniture leaves marks.	Treat soil with weed killer. Very important that base is well prepared. Use forms around edge to prevent crumbling.
BRICK	Adds year-round warm colors to garden. Combines well with other paving materials. Easy to handle, easy to install.	Simple to install in sand. Has warm colors; nonslip; very little glare. Variety of patterns, colors, and joint materials possible.	May crack, crumble, and heave in freezing weather. Weeds grow through joints. Not recommended for game areas.	Few tools needed. Laid most easily in sand. Mortar bed, mortar joints, concrete slab bed are other possibilities.
CONCRETE	Use wide range of textural effects and colors to eliminate commercial look. Use dividers to break up large areas. Combines well with other paving materials and plantings.	Can be applied quickly to large areas. Easy to handle in small batches. Good for outdoor games and dancing. Permanent, durable.	Hot in summer; glaring; shows stains; commercial-looking. Cracks and buckles; hard to patch.	Sometimes laid on stable soil, but gravel sub-base is better. Use headers and dividers to keep areas small and workable.
FLAGSTONE	Permanent, high quality type of paving. Blends well with garden colors.	Wide range of subdued, mellow colors. Permanent. Withstands winter freezing action.	High cost of material. Irregular shapes and colors. Hard and cold-looking. Slippery when wet.	Can be set on stable soil, 1 to 2 inch sand base, or on a concrete base with mortar joints.
LOOSE AGGREGATES	Use for temporary effect or to supplement main paved areas. Offer a variety of color and textures at low cost.	Low cost. Easy to put in place. Adds color to the garden plan. Variety of textures available.	Gets kicked into flower beds and onto lawns. Tracks on shoes. Hard to walk on in high-heeled and open-toed shoes. Requires constant upkeep because of weeds.	Use stable soil or rock base for best results. Gravel, limestone chips, and crushed brick should be up to 2 inches thick. Tanbark: spread 2 to 3 inches thick. Place on black plastic to reduce weed problem.
TILE	Gives garden a dressy, finished look. Combines well with brick and concrete. Has warm range of colors.	Colors blend well with garden plantings. Smooth, hard; does not absorb grease; good for dancing and games.	Formal-looking; not good for natural setting. Expensive. Requires careful craftsmanship.	Set in soil or 1-inch sand layer, with ½-inch joint. For a permanent job, use 1-inch mortar bed on 3-inch concrete slab with ½- to ¼-inch joints.
WOOD	Most natural effect of all pavings. Soft wood colors and textures blend well with plantings.	Color and texture of wood form a natural background for rest of garden plan. Lasts many years if treated with preservative. Redwood, cedar, or cypress recommended.	Temporary paving. Subject to decay, insects, and splitting. Slippery when wet.	Place on stable, level soil or on 1-inch of sand, with grass joints. Can be set in mortar bed, but not recommended.

STUDENT WORKSHEET

PLANNING A PATIO CONSTRUCTION PROJECT

Instructions: Estimate the amount and cost of materials and the amount of person hours required to construct a 300 square foot patio. Also, indicate tools needed to complete the job and step-by-step construction procedures.

1. Name of project: Constructing a 300 Square Foot Patio

2. Materials needed to complete project:

MATERIAL	AMOUNT NEEDED	COST

3. Tools needed:

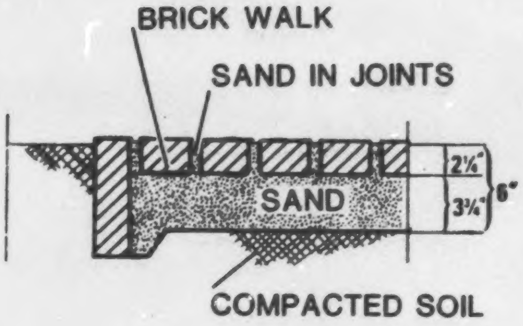
4. Construction procedure (steps):

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

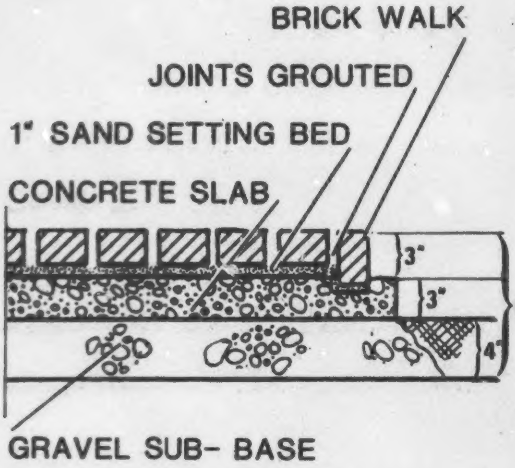
5. Estimated person hours required to complete job: ______________

PATIOS AND WALKWAYS

SCALE 1"= 1'-0"

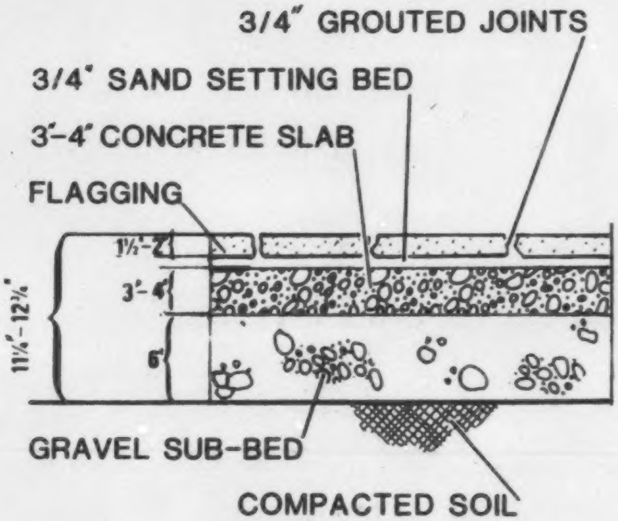

BRICK WALK
SAND IN JOINTS
SAND
2¼"
3¾"
6"
COMPACTED SOIL

BRICK ON SAND

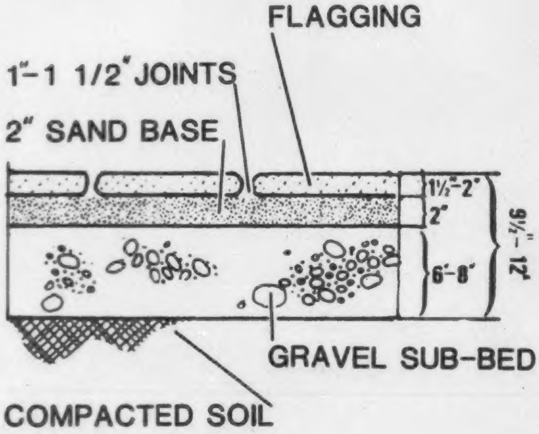

BRICK WALK
JOINTS GROUTED
1" SAND SETTING BED
CONCRETE SLAB
3"
3"
6"
4"
GRAVEL SUB- BASE

BRICK ON CONCRETE

SLOPE 1/4" PER FOOT

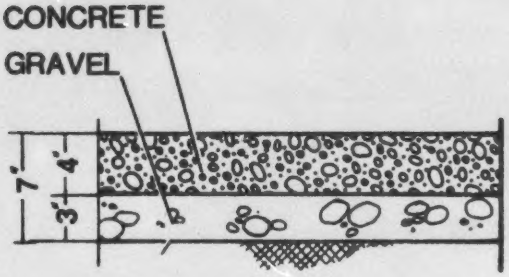

3/4" GROUTED JOINTS
3/4" SAND SETTING BED
3"-4" CONCRETE SLAB
FLAGGING
1½"-2"
3"-4"
6"
11½"-12¾"
GRAVEL SUB-BED
COMPACTED SOIL

FLAGSTONES ON CONCRETE

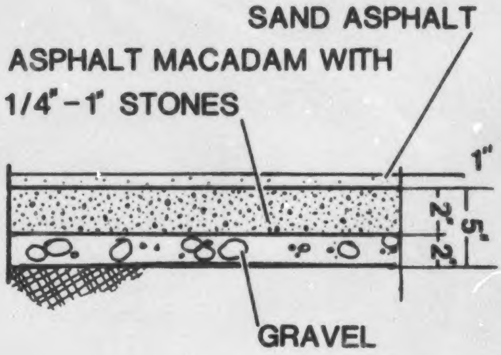

FLAGGING
1"-1 1/2" JOINTS
2" SAND BASE
1½"-2"
2"
6"-8"
9½"-12"
GRAVEL SUB-BED
COMPACTED SOIL

FLAGSTONES ON GRAVEL

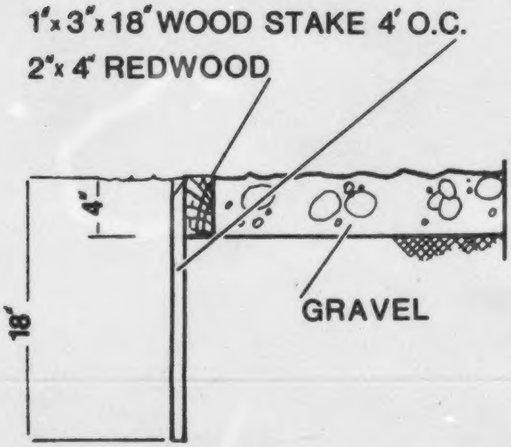
PATIOS AND WALKWAYS continued


CONCRETE
GRAVEL
7"
4"
3"

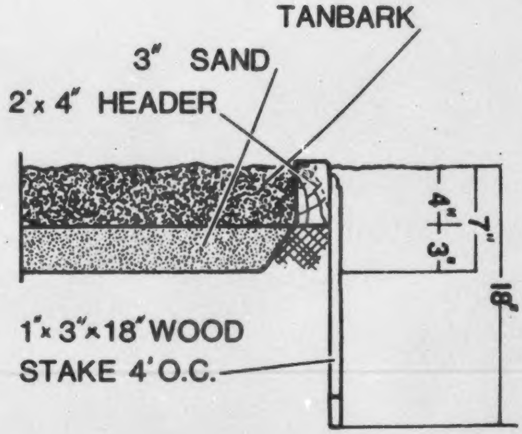
CONCRETE


SAND ASPHALT
ASPHALT MACADAM WITH
1/4"-1" STONES
1"
2"
5"
2"
GRAVEL

ASPHALT


1"x 3"x 18" WOOD STAKE 4' O.C.
2"x 4" REDWOOD
4"
18"
GRAVEL

GRAVEL

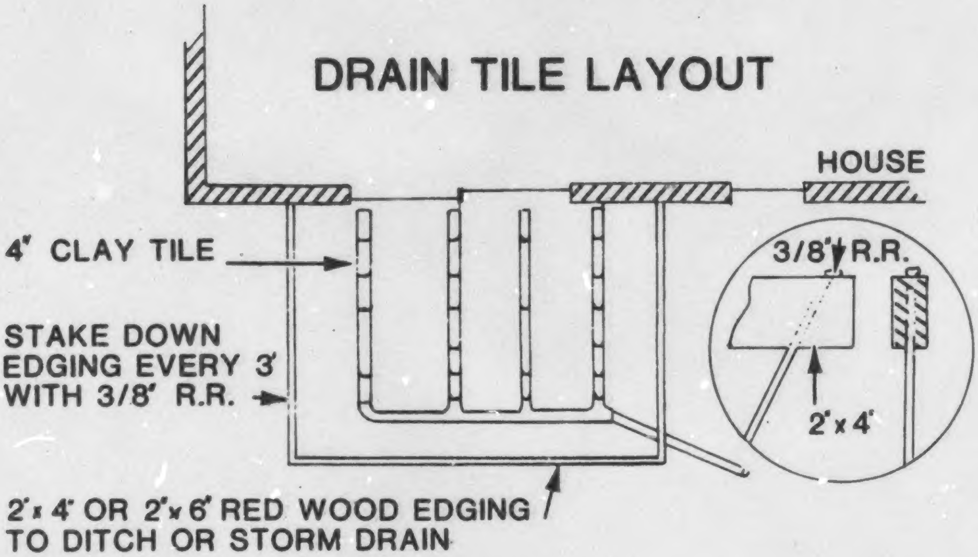

TANBARK
3" SAND
2"x 4" HEADER
7"
4"
3"
18"
1"x 3"x 18" WOOD
STAKE 4' O.C.

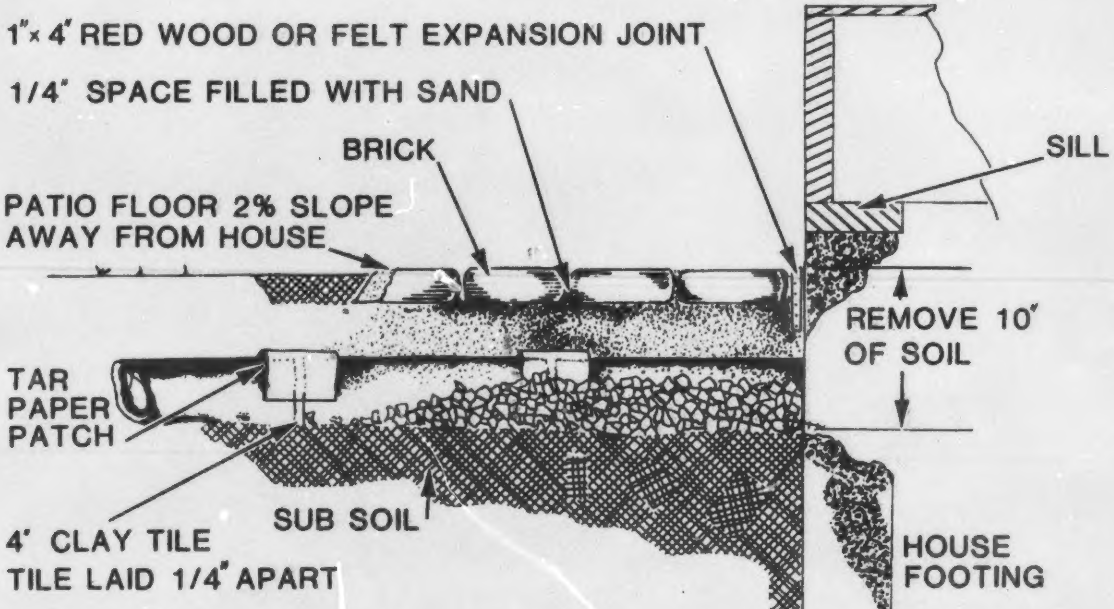
TANBARK

SCALE 1"=1'-0"

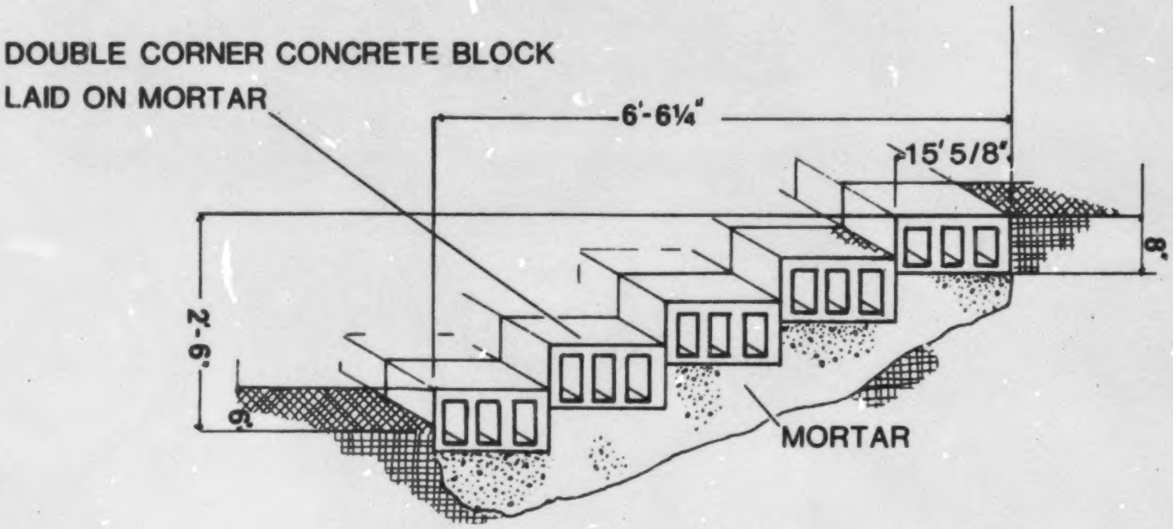
FREE-LAID BRICK PATIO

DRAIN TILE LAYOUT


HOUSE
4" CLAY TILE
3/8" R.R.
STAKE DOWN EDGING EVERY 3' WITH 3/8" R.R.
2"x 4"
2"x 4" OR 2"x 6" RED WOOD EDGING
TO DITCH OR STORM DRAIN

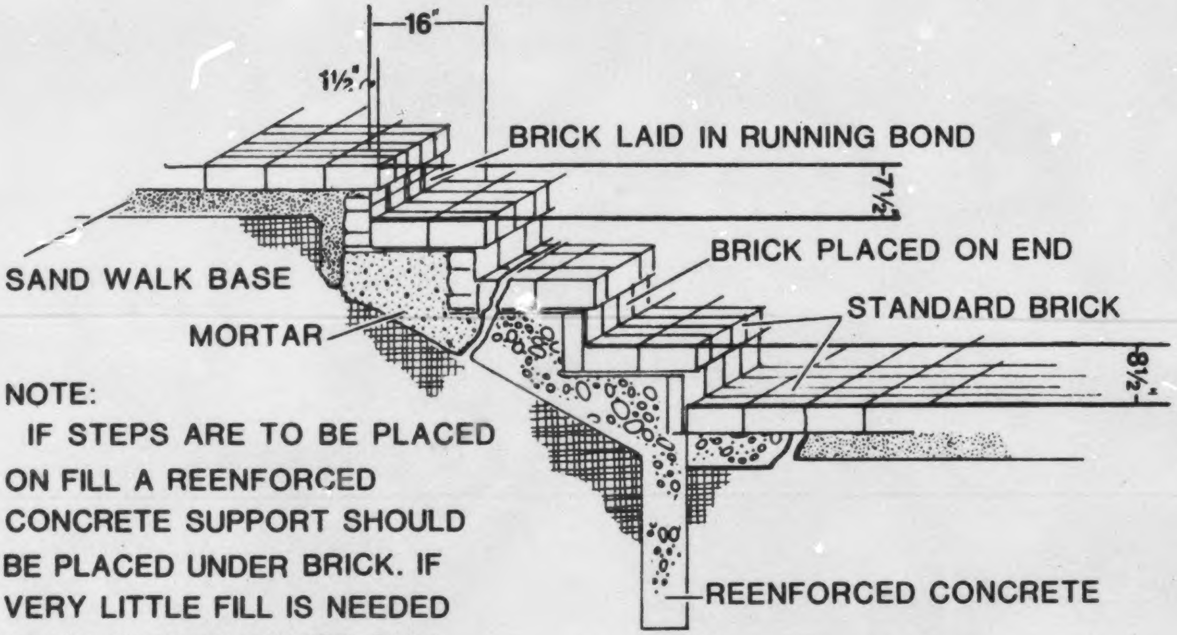

1"x 4" RED WOOD OR FELT EXPANSION JOINT
1/4" SPACE FILLED WITH SAND
BRICK
SILL
PATIO FLOOR 2% SLOPE AWAY FROM HOUSE
REMOVE 10" OF SOIL
TAR PAPER PATCH
SUB SOIL
4" CLAY TILE
TILE LAID 1/4" APART
HOUSE FOOTING

STEPS


DOUBLE CORNER CONCRETE BLOCK LAID ON MORTAR
6'-6¼"
15' 5/8"
8"
2'-6"
6"
MORTAR

CONCRETE BLOCK STEPS

SCALE 1/2"=1'-0"


16"
1½"
BRICK LAID IN RUNNING BOND
7½"
SAND WALK BASE
BRICK PLACED ON END
STANDARD BRICK
MORTAR
8½"
REENFORCED CONCRETE

NOTE:

IF STEPS ARE TO BE PLACED ON FILL A REENFORCED CONCRETE SUPPORT SHOULD BE PLACED UNDER BRICK. IF VERY LITTLE FILL IS NEEDED BRICK CAN BE PLACED ON A MORTAR SUPPORT.

BRICK STEPS

SCALE 1/2"=1'-0"

SAMPLE TEST QUESTIONS AND TEACHER'S KEY

CONSTRUCTING PATIOS AND WALKWAYS

True (T) - False (F)

T 1. The top of any edging material should meet the soil level.

F 2. Chimney bricks are an excellent material for walks and patios.

T 3. Materials used in landscape construction should fit the overall design.

T 4. In Illinois, freezing and thawing is a major force causing the destruction of walks and patios.

F 5. Most woods are decay-resistant and do not need to be treated with preservatives for use outside.

T 6. Free-laid brick should have about 4 inches of sand or screening as a base.

F 7. It is best to leave ½ inch spacings between individual bricks.

F 8. Brick walks will seldom shift if laid on hard clay.

F 9. Patios should be constructed with at least a 12% slope away from the house.

T 10. When using flagstone for walks or patios, it is best to use only larger pieces.

11. Explain why sand, screening, or gravel must be well settled before laying brick, flagstone, or concrete.

12. Brick, concrete, asphalt, and gravel are paving materials. Give an advantage and disadvantage of each.

UNIT L: LANDSCAPE DESIGN, ESTABLISHMENT AND MAINTENANCE

PROBLEM AREA: TRANSPLANTING, FERTILIZING, AND WATERING TREES AND SHRUBS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with tenth-grade or second-year students in a horticultural or agricultural occupations program. The recommended time for teaching this problem area is during the spring semester.

The estimated instructional time for this problem area is three to five days, depending on how far the teacher wishes to go in developing transplanting, fertilizing, and watering skills at the second-year level. If the teaching plan is limited to classroom discussion with little or no practice or observation, the instructional time can be three days or less. If the students are to be involved in other activity exercises, the instructional time will need to be increased.

The instructor is encouraged to conduct a local search to locate other supplementary materials for use with this problem area. The items in this problem area are for reference or modification as instructors adapt this problem area to their local situation.

CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-32-D-0542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education, Research and Development Section, 100 N. First St., Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the Illinois State Board of Education or its staff.

The teacher's guide, student information sheet and test questions were developed by Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Metropolitan Core Curriculum Pilot Test Teachers.

TEACHER'S GUIDE

I. Unit: Landscape design, establishment and maintenance

II. Problem area: Transplanting, fertilizing, and watering trees and shrubs

III. Objectives: At the close of this problem area students will:

1. Be able to properly transplant trees and shrubs.
2. Be able to provide post-planting care to newly planted trees and shrubs.
3. Be able to correctly fertilize and water trees and shrubs.

IV. Interest approaches:

1. Bring a balled and burlapped shrub, a bare-root shrub, and a containerized shrub to class and ask:

   What are the advantages of each?

   Which would you prefer to plant?

   Which has the greatest chance of survival? Why?

2. Display a picture of a redwood tree and ask the class a series of questions:

   How would you transplant this tree?

   What would you need to do to keep this tree alive?

   How would transplanting this tree differ from transplanting a 2" caliper tree?

V. Anticipated problems and concerns of students:

1. How do I ball and burlap a tree or shrub?
2. What size should the soil ball be for a balled and burlapped tree or shrub?
3. What are the advantages of a mechanical transplanting machine?
4. What is dessication?
5. When is the best time of the year to transplant trees or shrubs?
6. How do bare-root, balled and burlapped, mechanially transplanted, and containerized trees and shrubs differ?

7. Should the soil for backfilling be amended?
8. How large should I dig a hole for planting a tree or shrub?
9. Should twine and burlap be removed from the soil ball when transplanting?
10. What is the purpose of soil saucer?
11. When should additional drainage be provided?
12. How can drainage be provided?
13. Should newly-planted trees be pruned?
14. How do I wrap a tree trunk?
15. Should newly-planted trees be braced?
16. How often should I water a newly-planted tree or shrub?
17. When should I water established trees and shrubs?
18. How often should trees and shrubs be fertilized?
19. How do I apply fertilizers to trees and shrubs?
20. When should trees and shrubs be fertilized?

VI. Suggested learning activities and experiences:

1. Show VAS Slidefilm 641-3 "Proper Transplanting of Trees"
2. Discuss how to ball and burlap trees and shrubs and the best time of the year to transplant.
3. Take the class to a nursery to observe a mechanical transplanter in operation.
4. Have the students read pages 1-4 in VAS Subject Matter Unit "Transplanting Shade Trees".
5. Have the students ball and burlap a tree or shrub
6. Discuss the ways in which trees or shrubs are sold.
7. Have the students read pages 4-7 in "Transplanting Shade Trees" and lead a class discussion on planting trees and shrubs.
8. Discuss how poor soil drainage and heavy clay soils may be improved for trees and shrubs.

9. Have the students read pages 7-10 in "Transplanting Shade Trees."

10. Demonstrate how a newly-planted tree should be pruned.

11. Discuss watering, fertilizing, bracing and wrapping of newly-planted trees.

12. Discuss the death of trees and shrubs caused by dessication.

13. Plan a tree planting on Arbor Day (last Friday in April) involving the class. Seek help from the City or Park District and make it a community project.

14. Have the students read pages 1-9 in the VAS Subject Matter Unit, "Fertilizing and Watering Shade and Ornamental Trees."

15. Discuss how established trees and shrubs should be fertilized.

16. Have the students fertilize selected trees and shrubs on the school grounds.

17. Have the students read pages 9-10 in "Fertilizing and Watering Shade and Ornamental Trees."

18. Discuss when established trees and shrubs need water and how it can be applied.

VII. Application procedures:

1. Skills learned in transplanting and caring for trees and shrubs can be applied in the students' home situation.

2. The skills learned in this problem area will aid students employed at garden centers, landscaping companies, nurseries and City or Park District Forestry Divisions.

3. Encourage the students to have S.O.E.P.'s involving the transplanting and caring for trees and shrubs.

VIII. Evaluation:

1. Give satisfactory or unsatisfactory grade for participation in hands-on activities.

2. Administer a written test to the students at the close of this problem area.

IX. References and aids:

1. University of Illinois Vocational Agriculture Service Subject Matter Units:

5002	"Transplanting Shade Trees"
5003	"Fertilizing and Watering Shade and Ornamental Trees"

2. University of Illinois Vocational Agriculture Service Transparency Set "Landscape Planting and Bed Preparation"

3. University of Illinois Vocational Agriculture Service Slidefilms:

640	"Fertilizing and Watering Shade and Ornamental Trees and Shrubs" 48 frames
641-1	"Mechanical Digging of Trees and Shrubs" 74 frames
641-2	"Hand Digging Evergreens and Shrubs" 45 frames
641-3	"Proper Transplanting of Trees" 55 frames
686	"Packaging of Trees and Shrubs" 77 frames

INFORMATION SHEET

TRANSPLANTED BALLED AND BURLAPPED TREE

LOCATION - Before planting a tree, give careful consideration to where it will be located. Avoid areas that are known to collect water. Also, trees will find difficulty growing in soils that are extremely hard.

Trees should be planted far enough from buildings and other obstacles to allow for adequate sunshine, rain, air circulation and room for normal growth.

DIGGING THE HOLE - Dig a hole much larger than the tree ball. Allow for a minimum of 6 inches open space around the entire ball. Dig the hole at least 6 inches deeper than the height of the ball.

IMPROVING SOIL TEXTURE - Heavy clay soils common in parts of Illinois often need soil amendments. Thoroughly mix peat moss, compost or similar materials into the soil to be used for backfilling. The addition of organic materials will insure adequate aeration, water retention and good root growth.

PLACING THE PLANT - Place enough soil at the bottom of the hole so the tree can be planted at the same depth as it was before it was dug.

Nylon twine and green burlap resist decay and will strangle the tree roots and possibly kill the tree. To avoid this, remove them before backfilling and throw away.

Brown burlap will rot, so it may be left on. However, peel it back over the ball. Any burlap sticking above the ground will serve as a wick and draw water from the tree ball.

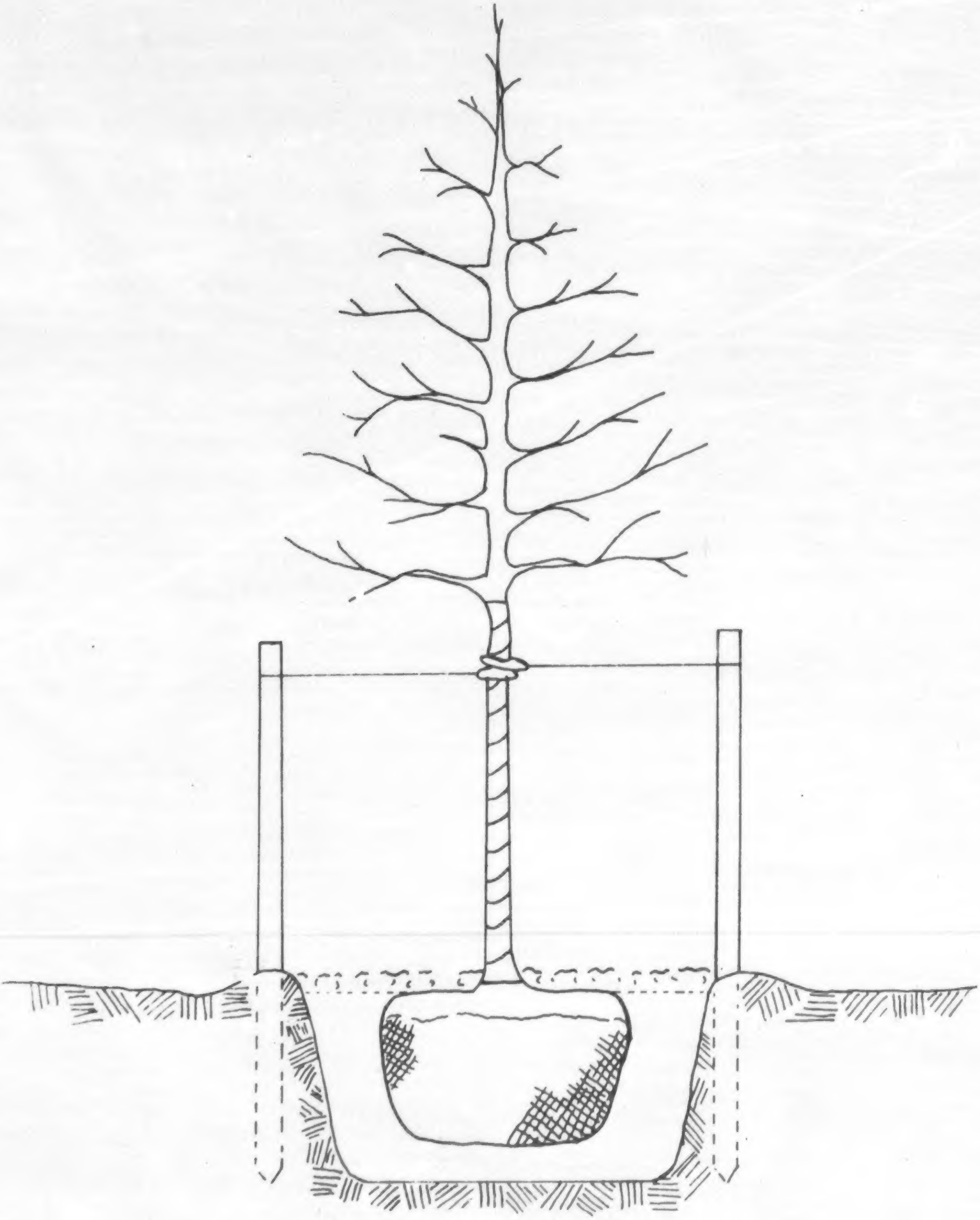
FILLING THE HOLE - Once the tree is properly positioned, backfill the hole halfway. Step this soil down to eliminate air pockets. Then, fill the hole to the top with water. Allow the water to be absorbed before completing the backfill process. Do not step down wet soil. Leave a soil lip circling the hole to form a basin for holding water. A 2 inch layer of mulch on top of the ball will help to retain moisture.

PRUNING - Newly planted trees should be pruned to compensate for the loss of roots when the tree was dug. Select branches to be removed carefully so as not to lose the natural growth habit of the tree. Make all cuts flush to the adjoining limb. DO NOT remove more than 30% of the existing crown.

WRAPPING - Protect the trunk of newly planted trees from sunscald and frost cracks by using tree wrap or burlap. Tightly wrap the material around the trunk and secure it with twine.

BRACING - Newly planted trees should be braced from movement to protect the tiny roots just developing. Use a minimum of 2 stakes for trees up to 3" in diameter. Drive the stakes outside the hole you have dug. This will provide more secure footing. Attach the tree to the stakes with a wire run through a piece of hose to avoid injury to the tree trunk. Trees with diameters larger than 3" will need three stakes.

WATERING - Recently planted trees need an abundance of water. Supply enough water to soak the soil around the roots at each watering. During prolonged dry periods it may be necessary to soak the soil every 10 days.



WORKSHEET

TRANSPLANTING, FERTILIZING, AND WATERING TREES AND SHRUBS

1. A newly transplanted tree is most likely to die from ______________.

2. The best time of the year to transplant a tree or shrub is _________ or _________.

3. What are four ways in which trees are sold?

    1.
    2.
    3.
    4.

4. List the steps involved in planting a balled and burlapped tree.

    1.
    2.
    3.
    4.
    5.
    6.
    7.
    8.
    9.

5. List four ways a tree may be fertilized.

    1.
    2.
    3.
    4.

6. What are the advantages of fertilizing trees and shrubs?

7. When applying dry fertilizer to the root zone of trees, holes _______ deep should be drilled about _____ apart beneath the canopy of the tree.

8. The best time to fertilize trees and shrubs is in _______ or _______.

9. When watering established trees, the equivalent of _______ inch(es) of rainfall should be applied every ___________.

10. The soil should be soaked to the depth of __________.

11. Newly transplanted trees may need to be watered every _________.

TEACHER'S KEY TO WORKSHEET

TRANSPLANTING, FERTILIZING, AND WATERING TREES AND SHRUBS

1. A newly transplanted tree is most likely to die from dessication.

2. The best time of the year to transplant a tree or shrub is spring or fall.

3. What are four ways in which trees are sold?

   1. Balled and burlapped
   2. Bare-root
   3. Mechanically transplanted
   4. Containerized

4. List the steps involved in planting a balled and burlapped tree.

   1. Dig a pit 2' wider than the tree ball
   2. Place the tree in the pit with the top of the ball level with the surrounding ground
   3. Remove burlap, twine, and metal baskets
   4. Backfill to ½ the depth of the hole and tamp
   5. Fill the hole to the brim with water
   6. Complete the backfilling process
   7. Build a 6" soil saucer around the pit
   8. Mulch
   9. Fill the saucer with water

5. List four ways a tree may be fertilized.

   1. Broadcast dry fertilizer
   2. Drill holes and place dry fertilizer in the root zone
   3. Foliar application
   4. Soluble fertilizer pumped into the root zone

6. What are the advantages of fertilizing trees and shrubs?

   Grow vigorously; fertilized trees and shrubs and are resistant to diseases and pests

7. When applying dry fertilizer to the root zone of trees, holes 12" to 15" deep should be drilled about 2 feet apart beneath the canopy of the tree.

8. The best time to fertilize trees and shrubs is in spring or late fall.

9. When watering established trees, the equivalent of two inch(es) of rainfall should be applied every 2 weeks.

10. The soil should be soaked to the depth of 14 inches.

11. Newly transplanted trees may need to be watered every 7-10 days.

SAMPLE TEST QUESTIONS AND TEACHERS' KEY

TRANPLANTING, FERTILIZING, AND WATERING TREES AND SHRUBS

Multiple Choice

B 1. A rule of thumb when digging a tree is _____ inches of root ball diameter per 1" of tree trunk diameter.

a. five c. twenty
b. ten d. none of the above

D 2. A reason for mechanically transplanting trees.

a. reduce labor
b. extend the planting season
c. speed planting
d. all of the above

C 3. ________ is the most frequent cause of death of transplanted trees.

a. Dutch Elm Disease
b. Lawn mower damage
c. Dessication
d. Over watering

A 4. Which is the least common way in which large trees are sold.

a. bare-root
b. balled and burlapped
c. mechanically transplanted
d. containerized

D 5. ___________ may be an indication of a poorly drained site.

a. Heavy clay soil
b. Low areas
c. Loose soils
d. Both a and b
e. All of the above

D 6. The purpose(s) of wrapping the tree trunk is(are) _________.

a. prevents sprouts along the trunk
b. reduces damage from sun scald
c. protects thin bark from rodents
d. all of the above

C 7. __________________ is not a method of fertilizer application.

a. Dry fertilizer in holes
b. Injection of liquid fertilizer
c. Transpiration
d. Surface application

True (T) - False (F)

T 8. Newly-planted trees or shrubs are often pruned to maintain a balanced root to shoot ratio.

F 9. The hole for a balled and burlapped tree or shrub should be about the same size as the root ball.

F 10. Green burlap, pots, nylon twine and wire may all be planted with the tree because they will decay before tree roots are big enough to be damaged.

F 11. Always place several inches of soil over the root ball to insulate the roots during cold weather.

T 12. Bracing of newly-planted trees is necessary to provide stability and reduce the damage to developing roots.

T 13. It is helpful to add peat moss to clay soils before backfilling.

T 14. Fertilizer should not be applied within 2½ feet of the tree trunk.

T 15. Established trees usually do well with normal rainfall. If drought occurs, trees should be provided with an equivalent of 2 inches of rainfall.

Matching

16. G Tree
17. E Shrub
18. C Transpiration
19. H Mulch
20. D Transplanting
21. F Balled and Burlapped
22. B Fertilizer
23. J Bare-root
24. A Container
25. I Tree Wrap

A. Trees or shrubs grown in pots
B. Elements beneficial to plant growth
C. The loss of water vapor from plant tissues
D. The moving a tree or shrub from one location to another
E. Low-growing, multi-stem woody plant
F. Trees or shrubs with a ball of soil around the root system
G. Tall, usually single-stemmed woody plant
H. Straw, wood chips, and peat moss are good examples
I. Material used to protect trunks of trees
J. Trees or shrubs without soil around the root system.